Scientific American

JANUARY
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TYPICAL CASE—MILLING MACHINE

Here is how War Assets Administration s new price has been set for a typical machine Model 2K Kearney and Trecker Milling Machine vertical knee action War Assets Administration S C Code 3417 23 20 28

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Available for rebuilding	511 00

Sales to priority claimants which include Federal Agencies Certified Veterans World War II and subsequent priority claimants will be made in proper sequence as required by law

31 TYPES OF GENERAL PRODUCTION TOOLS REPRICED

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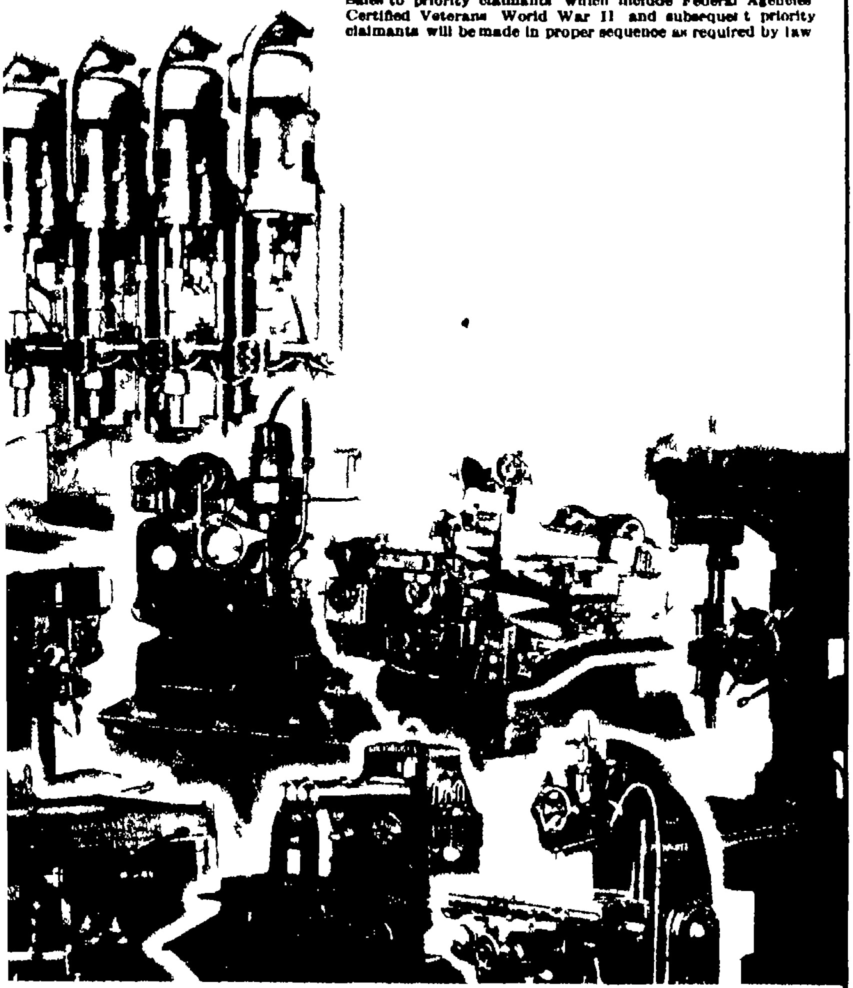
Chucking Machine—Automatic Vertical Multiple Spindle Type
Chucking Machine—Single Spindle Automatic, Horizontal Turret Type Machine
Chucking Machine—Six Spindle Automatic Horizontal
Drilling Machine or Drill Press—Bench or Floor Single or Multiple Spindle
Gear Cutting Machine for Straight Bevel Gears (Not Planer Type)
Gear Hobber—Horizontal
Gear Hobber—Vertical Universal
Gear Shaper—For External Spur Gears Only
Gear Shaper—For Spur Gears External or Internal
Gear Shaper—For Spur and Helical Gears External and Internal
Gear Tooth Shaver—For External and Internal Gears (Rotary Type Machine)
Gear Tooth Grinder—Generating Type for Spur and Helical Gears
Gear Tooth Grinder—For Spur Gears External and Internal (Formed Wheel Type Machine)
Grinders—Centerless
Grinder—Crank Pin Grinders
Grinders—Plain External Cylindrical Grinder
Grinder—Internal Cylindrical Automatic Sizing
Grinder—Internal Cylindrical (Hydraulic Feed Machine)
Grinder—Internal Cylindrical Hydraulic Feed for Hole and Face Grinding
Grinder—Surface Rotary Table Type
Lathe—Multiple Tool Not Automatic Manufacturing Type Production Lathe
Milling Machine—Automatic and Manufacturing Knee Type
Milling Machine—Plain Bed Type Horizontal Spindle Machines
Milling Machine—Vertical Knee Type (Not Including Bench Type)
Polishing and Buffing Machine—Bench and Floor
Profiling Machine—Vertical Fixed Bed Type Single and Multiple Spindle
Tapping Machine—Vertical Single or Multiple Spindle
Thread Grinding Machines
Thread Milling Machine
Turret Lathe—Ram Type Plain and Universal



MACHINE TOOL

SALES DIVISION

BELOW MARKET

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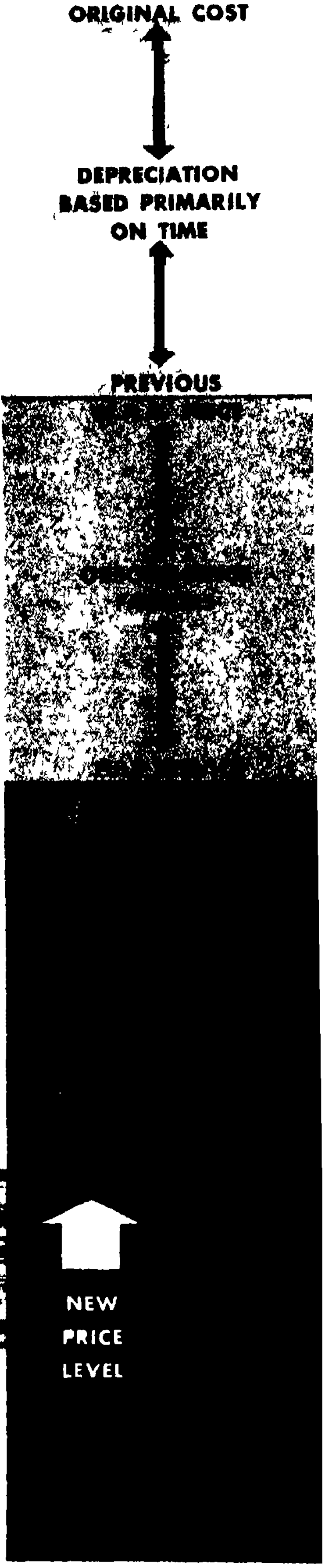
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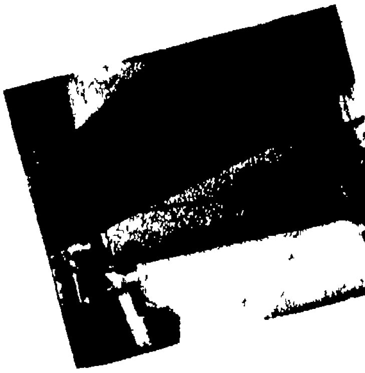

INDUSTRIAL DRAMA: *Pipe of asbestos and cement, and with a number of outstanding physical characteristics is made on the machine illustrated on our front cover In this Johns-Manville photograph, a completed length of pipe, ready to be taken from the mandrel and cured, is shown in the foreground See article on page 27*

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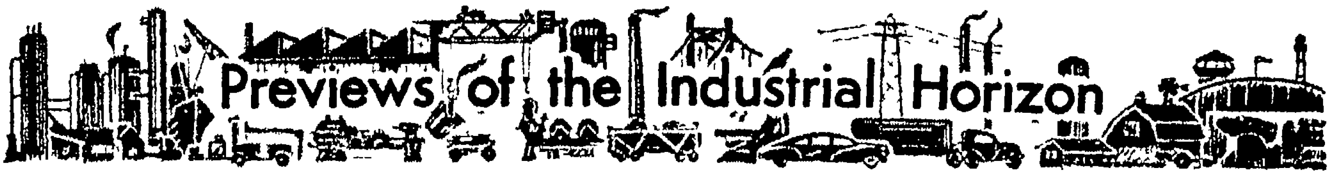

Previews of the Industrial Horizon

Previews of the Industrial Horizon

By A. P. Peck

DIESELS, FUEL, AND POWER

Manufacturers of the most efficient machines known today for converting oil to useful energy—Diesel engines—are faced with a serious problem Their engines, by some mistakenly thought to thrive on almost any kind of fuel that is fed to them, deliver their peak efficiency only when operated on the right fuel (See also "A New Diet for Diesels?" page 21, this issue)

But here's the present catch The best grades of Diesel fuel, formerly a by-product of petroleum refining which the refiners were glad to get rid of at a reasonable price, now loom large in the production of high-octane gasoline Catalytic cracking is the answer Cat-crackers take in good Diesel (and furnace) oil in the process of turning out gasoline at a higher profit So it looks as though, if this trend continues, Diesel users are facing the possibility of constantly increasing fuel costs

Of course it is probable that Diesels could be redesigned to use the poorer grades of gasoline-production by-products that result from cat-cracking processes, but this would tend to obsolete some 97 million installed horsepower of Diesels now rendering good service Also, the poorer fuel oils would vitiate many of the advantages of the Diesel that are just becoming recognized

Disregarding, for the purposes of this discussion, any selfish motives of either the Diesel engine manufacturers or the producers of Diesel fuel, there is one single point of interest and importance to every man, woman, and child in the United States This point involves the conservation of oil supplies The Diesel—whether on board ship, in a locomotive, doing humble service in a power plant, propelling a heavy-duty truck on the highway, of whatever—is turning out the greatest amount of energy per gallon of crude removed from the bowels of the earth And these gallons are limited in number It is simple logic, then, to conserve them by putting them to the most efficient use

Gasoline is essential to our national economy, of course But so are the Diesels, and increasingly so There must be a meeting of minds in the Diesel and petroleum industries, to the end that each will benefit to the other's advantage

N B—American Diesels today consume a billion and a half dollars worth of fuel annually Some 64 percent of the world's shipping is propelled by Diesels American trucking is wide-open to Diesels, as yet only less than 1 percent of the trucks on our highways are Diesel equipped, leaving a fertile market if engine makers and fuel producers can see eye-to-eye for the future conservation of petroleum as a power producer

HOW DOES IT SMELL?

Does the product of your company have a characteristic odor? If it does, you may not even be aware of it But it is quite possible that customers and potential customers are—and therein may lie the difference between a rising sales curve and one doing a nose-dive It is really astonishing to find what effects odors can have on ultimate purchasers, and this applies to hard-boiled purchasing agents as well as to members of the fair sex selecting their stockings and filmy undergarments in their favorite store

Here are a few cases in point Female employees in an industrial plant objected to a permeating odor around their machines Specialists investigated, found an oil to be the offender Addition of a chemical odor-suppressor saved the day Plastics handbags sell better in department stores if they are first treated to remove their natural odor Scented hosiery is bought in prefference to unscented hosiery but, oddly enough, a survey has shown that purchasers are not consciously influenced by the odor, they imagine that the scented goods have a better texture or a more appealing color, although texture and color are identical Here the nose obviously over-rules the other senses

The list lengthens Manufacturers of such diversified things as carbon-paper, shoe-polish, paints, textiles, waxes, rubbers, and so on, are applying the odor-improving technique to their products with increasingly effective results

NEW PRODUCTS FROM OLD

Taking things apart and putting the parts together again to form entirely new products is a favorite pastime of the industrial researcher Now M W Kellogg Company has come up with a new process, using liquified propane gas at a pressure of 500 pounds per square inch as a solvent, for separating a vast number of useful products from fish and vegetable oils At this pressure, a variation of one or two degrees, Fahrenheit, can mean the difference between producing a vitamin, a better soap ingredient, a paint that dries quicker, or more salad dressing Into the process can go fish oils, soybean oil, tallow, cottonseed oil, and the like Out of it comes refined products of greatly increased value, at a relatively low cost per pound for processing

STRAWS IN THE WIND

Keep an eye on Brazil as an important future source of raw materials for industry in the United States as these lines go to press, the writer is leaving for an extended tour of the non-ferrous mines and mills of Brazil, report will appear next month Thin wood, held together with cotton tape and adhesives, is making its mark in the wooden box industry, where thick sections of materials were formerly thought indispensable

A new chemical, sprayed on trees and plants, seals out insects and fungus organisms, expands with growth, and is reported to have no deleterious effects on fruits or vegetables

50 Years Ago in . . .

(Condensed from Issues of January, 1897)

NICKEL STEEL — "Outside of the application of nickel steel by the United States Navy to armor, angles, rods, thin plates, engine shafting, hull plates, an experimental gun, the barrels of small arms, torpedo netting, etc., may be mentioned its application to bicycle frames and handle bars, steam boilers, and difficult steel castings In fact, wherever a tough metal of high resistance and low corrodibility is wanted, this alloy is applicable"

WELDED RAILS — "The first efforts to secure a continuous metallic joint in railroad rails were made by electrical welding and this was followed by what is known as cast welding As to the question of expansion and contraction of the rails due to change of temperature, it was proved in an experimental test at Johnstown, a few years ago, and in subsequent tests, that the elasticity of the steel is capable of accommodating such changes of length as take place Mr W K Bowen, superintendent of the Chicago City Road , stated that, of the 17,000 cast welded joints made on his road in 1895, only 154 were lost, and these breakages were due to flaws in the metal Comparative tests have shown the joint to be 'far stronger than the rail itself'"

GLASS BRICK — "A feature of the recent Stuttgart exhibition was a display of buildings which were constructed of what is known as the Falconnier's blown glass brick The bricks are blown hollow in the same way as a bottle, the color which is most commonly used being a very light bottle green, bottle glass being the strongest, though yellow brown or other shades of green may be used if desired . Perhaps the most valuable feature of these bricks is that the air which they contain is an excellent non-conductor of heat, and tends to keep a house cool in summer and warm in winter"

PAPER CLOTHING — "The Japanese have for a long time been making underclothing of their finely crisped or grained paper after the sheets have been pasted together at the edges so as to form large pieces"

ESCALATOR — "The accompanying engraving shows the working of a new style of elevator which is being put to a practical test by the trustees of the Brooklyn Bridge The elevator is placed to the right of one of the stairways that lead to the station platform. The belt, or movable flooring, has an inclination of 25 degrees, the vertical lift being 7 feet, and it travels at the speed of 80 feet per minute Broadly stated, the device is an inclined belt conveyor, similar in its action to those which are used for raising baggage from a steamer's deck to the dock level It consists of an endless belt, made up of transverse cast iron slats. The capacity of an elevator 20 inches wide is 3,000 persons per hour"

EXPORT — "There is no doubt that the American manufacturers of labor-saving machinery and implements are devoting more attention to the possibility of building up and extending an export business with foreign countries than they have done for many years"

PIGEONS — "The use of homing pigeons as messengers is said to have received considerable attention at the United States Naval Academy Many newspapers use pigeons as messengers with decided advantage for the transmission of news, and so some of the recent election returns were brought in by carriers Improvements in method and apparatus follow the new uses of the birds The old way of attaching a quill with the message to the tail feather of the homer has been improved recently by an invention of Prof Henri Marion, of the Naval Academy, a small water tight aluminum message holder, weighing less than eight grains, which can be fastened to the pigeons in an instant"

PATENT ATTORNEYS — "The public, it is to be hoped, are awaking to the fact that the personal element in patent practice needs purification. Under existing conditions, inventors themselves must do the purifying by selecting reputable firms for their representatives in Patent Office proceedings"

100 Years Ago in .

(Condensed from Issues of January, 1847)

BULLETS — "There is a machine employed in St. Louis in making bullets, of which it turns out 180 per minute — Two millions of balls have been shipped for the seat of war within two weeks"

UNION STATION — "A movement is being made at Worcester, Mass, to erect a new central depot which will accommodate and concentrate the business of all railroads, and promote the convenience of the public by enabling all the railroads coming into Worcester to centre at one point

WAR SHIP — "There is now before Congress the plan of a fireship, made by Mr Brown, of Illinois, for marine and harbor defence It is so constructed as to reflect off shot, while it is capable of enveloping in a single moment, an enemy's ship in a sheet of inextinguishable fire"

BRIDGE — "An iron bridge, in size and magnificence, perhaps, never before equalled, is about to be erected, with a corresponding viaduct across the Tyne, from Gateshead to Newcastle-upon-Tyne for the Newcastle and Berwick railway It is to consist of six cast iron circular arches, with a curved approach at each end. The span of the arches will be 125 feet, supported on pillars 21½ feet high, and 14 inches square"

STEAMER — "We learn from Pittsburgh that the iron steam-frigate Allegheny, will be completed and ready to launch in February next."

Drop wire undergoing abrasion tests in birch thicket laboratory. Below, the new drop wire now being installed

WE'RE GLAD THAT BIRCH TREES SWAY

The telephone wire which runs from the pole in the street to your house is your vital link with the Bell System. More than 17,000,000 such wires are in use.

The wire becomes coated with ice, it is ripped by gales, baked by sun, tugged at by small boys' kite strings. Yet Bell Laboratories research on every material that goes into a drop-wire—metals, rubbers, cottons, chemicals—keeps it strong, cheap, and ready to face all weathers.

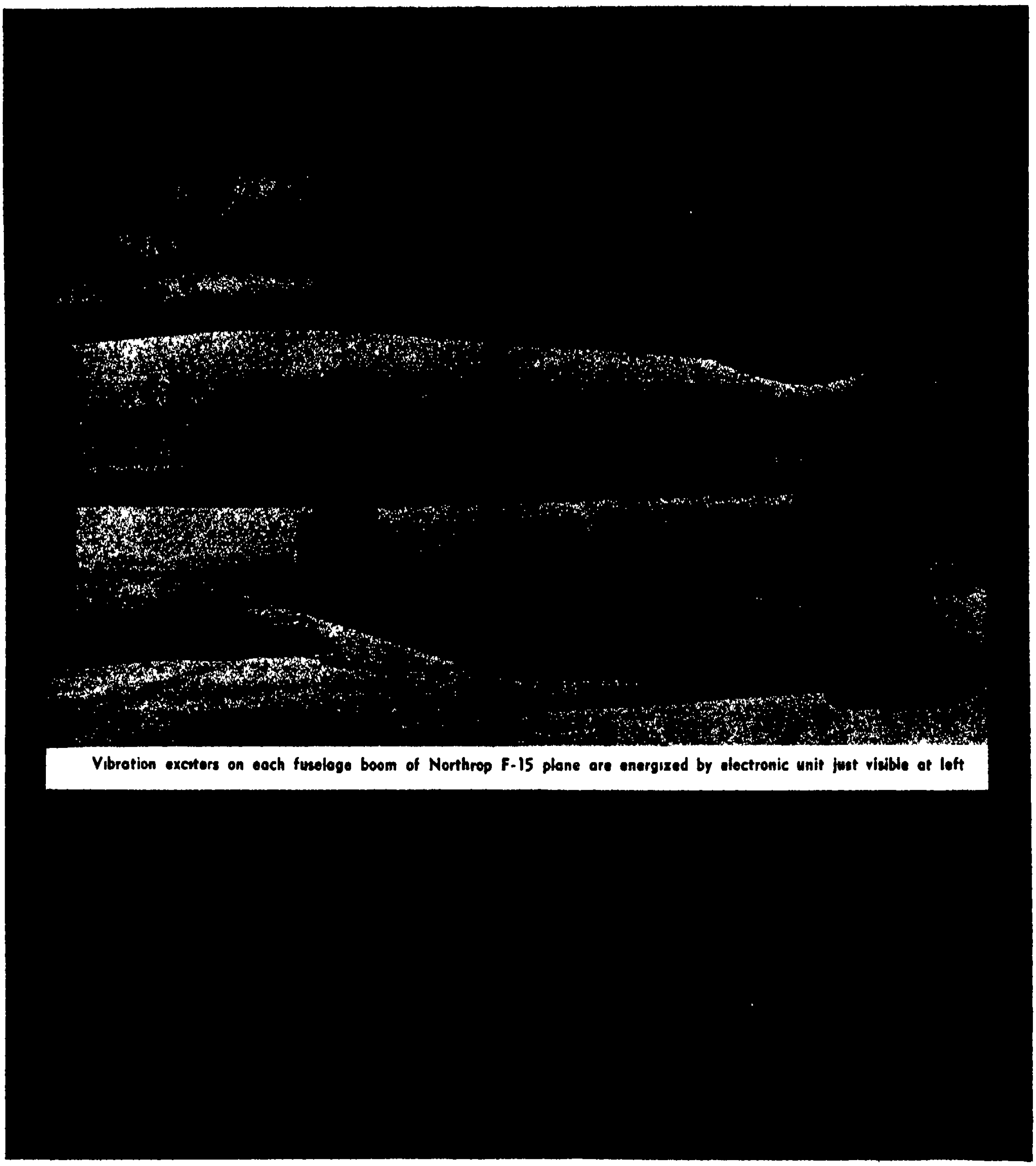
Now a new drop-wire has been developed by the Laboratories which lasts even longer and will give even better service.

It has met many tests, over 6 or 7 years, in the laboratory and in field experiments. It has been strung through birch thickets—rubbed, winters and summers, against trees, and blown to and fro by winds. In such tests its tough cover lasts twice as long as that of previous wires.

House by house, country-wide, the new wire is going into use. Wire is only one of millions of parts in the Bell System. All are constantly under study by Bell Telephone Laboratories, the largest industrial laboratory in the world, to improve your telephone service.

BELL TELEPHONE LABORATORIES

EXPLORING INVENTING DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE



Vibration exciters on each fuselage boom of Northrop F-15 plane are energized by electronic unit just visible at left

Vibration Effects, Sometimes Revealed by Structural Failures, and Always Hard to Evaluate In Design, Are Accurately and Safely Tested by Electromagnetic Vibrators With These Units, Forces of Controlled Amplitude and Frequency are Conveniently Used on Critical Members

By JOHN MARKUS
Associate Editor *Electronics*

With a distinct trend in industry toward light metals and high speeds for machines as well as motor vehicles and aircraft, vibration testing becomes an important field of investigation As speeds go up, flutter tests become increasingly more valuable, and are absolutely essential in aircraft and rockets approaching or exceeding the speed of sound

Great bridges, designed to withstand static loads with an ample margin of safety, have crashed to destruction once set in vibration by gusts of wind, critical moving members of machines have failed mysteriously after long periods of satisfactory service, simply because metals get tired or fatigued when subjected to apparently insignificant vibration for a long period of time

Exposing experimental structures to electronically produced and controlled vibrations at accelerated rates is a simple and effective way of determining beforehand whether designers have properly allowed for

• LOOKING AHEAD •

Fewer mysterious structural "accidents". . Longer life for machinery subjected to vibration. More efficient, lighter designs through elimination of unneeded "beef". . . Smoother riding buses and trains on better spring suspensions.

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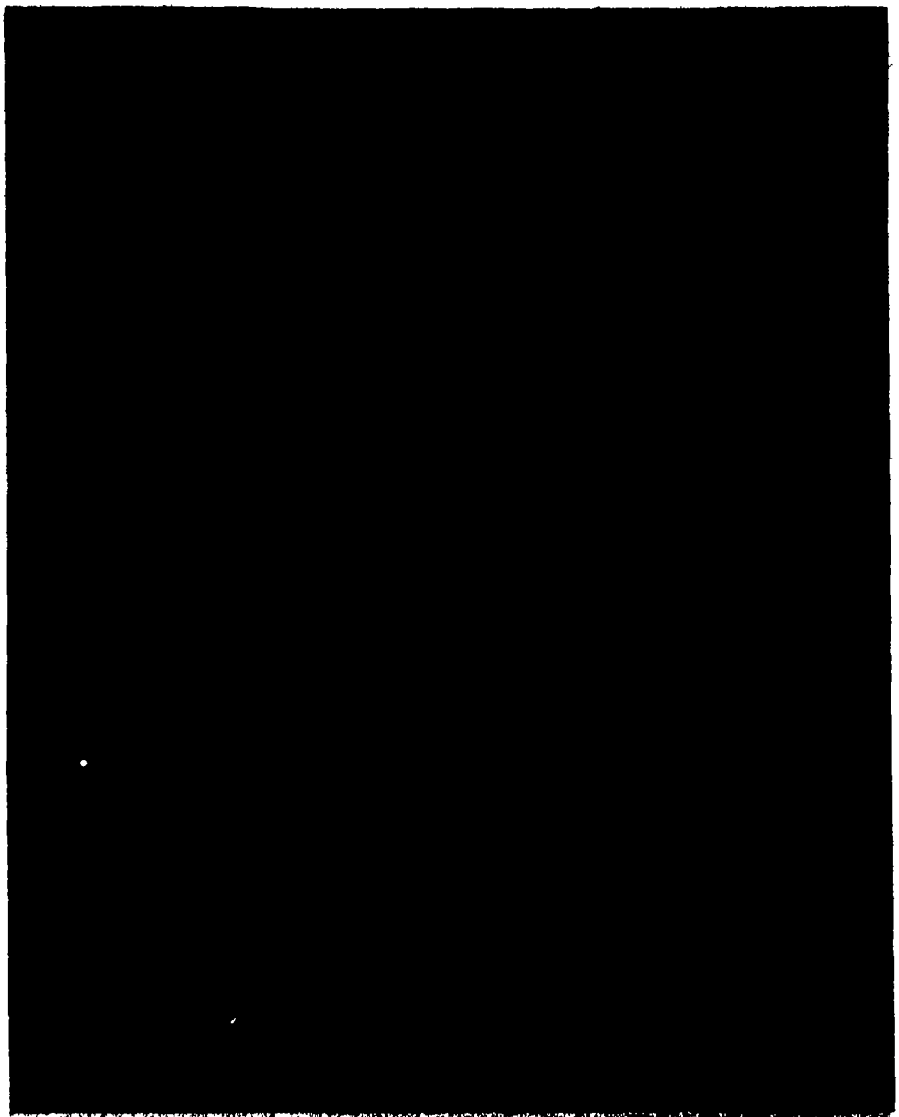
the most severe conditions of vibration that might be encountered in actual use Thousands of dollars can be saved and many human lives and injuries can be spared by making such failures occur before a single production model has left the factory, and by correcting design faults before they can take their toll.

To accomplish such testing, the principle of resonant vibration is now being utilized in an electronic vibration exciter for structural tests One or more shaker units, each essentially like a radio loudspeaker without the latter's paper cone, are positioned near the automobile body, structural beam, aircraft fuselage, or other structure to be tested The moving element of each shaker is coupled to a metal rod that fits onto a rubber suction cup attached to the structure Thus the shaker need only be energized at the natural vibrating frequency of the structure in order to produce, in a few minutes, vibrating forces so strong that iron beams snap in two, huge aircraft fuselages pop or "oilcan" like a child's toy cricket, and 30-ton bombers actually bounce off their landing wheels



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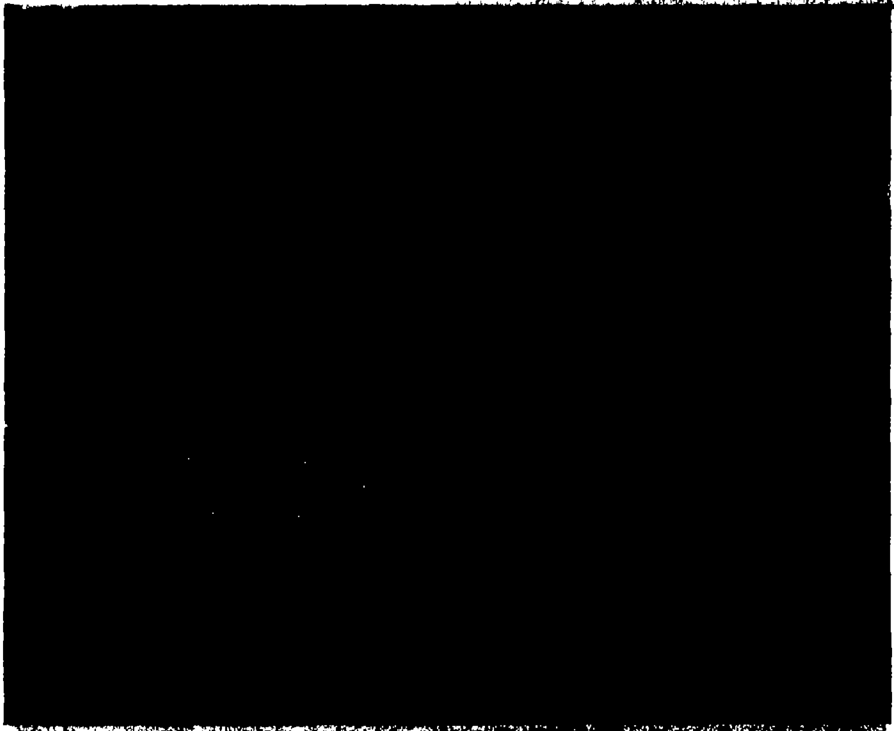

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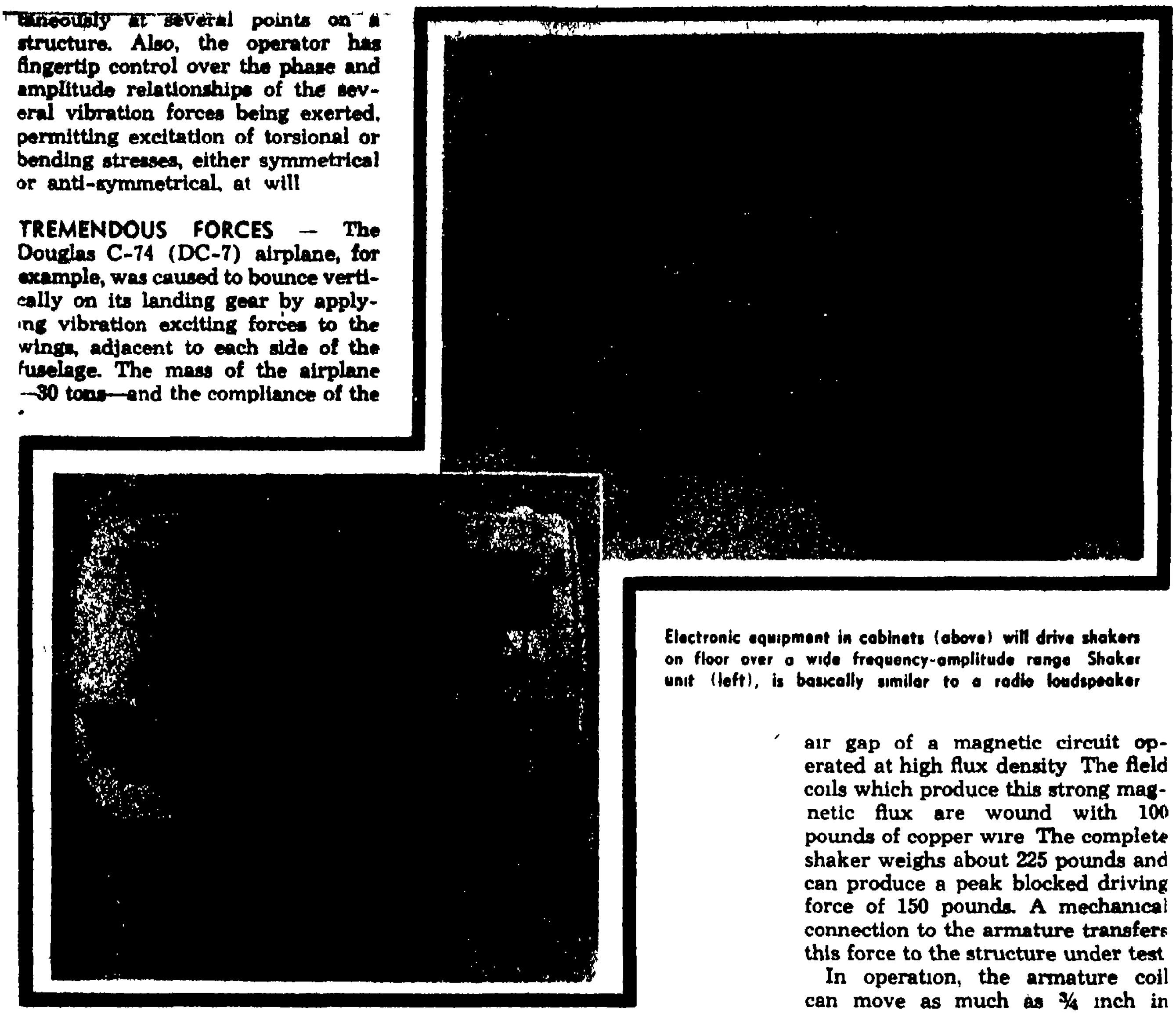
Finding the right vibrating frequency and supplying sufficient power to the shakers at that frequency is the job of the two electronic cabinets which constitute the heart of this new structural testing equipment. Made by The Rollin Company, the electronic vibrator is primarily designed for making flutter tests on large aircraft structures It provided separately exciting vibration at each mechanical resonant frequency of the unit under test, as contrasted to brute-force mechanical apparatus by which vibration is created through the use of a rotating unbalanced mass driven by a constant-speed motor

In comparison with such mechanical systems, the electronic method offers a much greater flexibility and far more accurate control over the vibration forces being applied. When desired, vibration forces may be established accurately and simultaneously at several points on a structure. Also, the operator has fingertip control over the phase and amplitude relationships of the several vibration forces being exerted, permitting excitation of torsional or bending stresses, either symmetrical or anti-symmetrical, at will

TREMENDOUS FORCES — The Douglas C-74 (DC-7) airplane, for example, was caused to bounce vertically on its landing gear by applying vibration exciting forces to the wings, adjacent to each side of the fuselage. The mass of the airplane —30 tons—and the compliance of the tires resonated at a frequency of 114 cycles per minute Two electromagnetic shakers were used and the peak force required to produce the vertical bouncing was only 45 pounds per shaker Thus, tremendous mechanical forces can be developed through the phenomenon of resonance



Electronic equipment in cabinets (above) will drive shakers on floor over a wide frequency-amplitude range Shaker unit (left), is basically similar to a radio loudspeaker

In another test, the wing of a large airplane was excited by anti-symmetrical bending forces. These imparted a torsional motion to the fuselage, causing the entire tail assembly to whip from side to side and making the fuselage produce loud snapping sounds like those of an oilcan being pressed on the bottom.

The equipment is also ideally suited for making accelerated repeated load or fatigue tests—to the point of failure or destruction—to determine the physical properties of various structural members or certain materials. A resonant force of 200 pounds, for example, may be exerted alternately in tension and compression on a sample structural member for 80,000 cycles in two hours A similar test employing motor-driven, cam-operated apparatus operating at the rate of 10 cycles per minute would require well over 100 hours

An outstanding factor in this method of fatigue testing is that incipient failure of the sample throws the system off resonance The resonant frequency is reduced and continuing reduction is an indication of impending failure of the sample material.

The driving force of the testers is produced by electromagnetic vibration motor or shaker units employing the same principle as the electro-dynamic loudspeaker of a radio set. These shakers are energized by a vacuum-tube oscillator and power amplifier The frequency of the oscillator can be controlled over a range from two cycles per second to over 500 cycles per second

A shaker that comprises a movable armature coil suspended in the air gap of a magnetic circuit operated at high flux density The field coils which produce this strong magnetic flux are wound with 100 pounds of copper wire The complete shaker weighs about 225 pounds and can produce a peak blocked driving force of 150 pounds. A mechanical connection to the armature transfers this force to the structure under test

In operation, the armature coil can move as much as ¾ inch in either directions from the rest position, less than five pounds of pull being required to move it all the way A unique copper suspension system keeps the coil centered in the air gap during motion

PHASE RELATIONSHIPS — Many vibration tests require means for applying vibration forces of different phase to two points on a structure, such as for creating torsional types of vibration. For this reason, two identical electronic exciters are provided, each in its separate cabinet and driving its own pair of shakers If only one pair of shakers is required the unused unit then serves as a standby set, a desirable feature since interruption of tests on a large structure is quite expensive

In addition to controlling the phase, the amplitude relationship between the two cabinets and pairs of shaker units can be continuously controlled to the point where one pair of shakers produces a relatively low driving force while the other pair is producing a high driving force In this manner, sweeping of the point of application of the vibration force being applied to a structure may be varied at will. The equipment is flexible, and the various types of tests which can be set up is limited only by the ingenuity of the operator

Smaller shakers are available for testing small structures and for use in locations where it is difficult to mount the standard shaker units

Symmetrical bending forces may be produced in a structure by attaching the two shaker units adjacent to but slightly beyond the nodal points in the vibrating structure and operating the shaker units in phase Symmetrical wing bending in an airframe, for example, is obtained by attaching one shaker unit to the left wing and the other shaker unit to the right wing at a point inboard from each wing tip equal to approximately one third the total wing span of the aircraft Anti-symmetrical bending, on the other hand, is obtained by attaching the two shaker units to approximately the same point as for symmetrical bending, but with the shaker units operated 180 degrees out of phase By changing the phasing switch on the electronic control panel from zero to 180, either symmetrical or anti-symmetrical bending can be quickly obtained

Simple bending stresses in a cantilever beam are obtained by attaching a single shaker unit at a suitable point along the length of the beam The greatest resonant forces are produced and the largest force is exerted by the shaker unit when it is attached to the beam at a point adjacent to the fulcrum at a distance equal to not more than one fourth the total length of the beam

Torsional vibration may be obtained by attaching the shaker units to opposite edges of the structure The two shakers are then operated with an 180-degree phase relation so a rotational motion is imparted to the structure under test In testing the wing of an aircraft, one shaker unit is attached adjacent to the leading edge and the other adjacent to the trailing edge of the wing, and the frequency dial of the oscillator is adjusted until torsional resonance occurs

CONVENIENT APPLICATIONS — The shaker units are most conveniently attached to a structure by means of rubber suction cups A cup between four and six inches in diameter, having a short length of metal shaft 3/8 inch in diameter extending from the rear of the cup, is usually satisfactory

The shaker units may be mounted on movable platforms of such height as to provide for their attachment to a desired point on the structure being tested These platforms must be rigidly constructed to prevent resonance from occurring which might cause the platform to collapse In certain cases, when it is not convenient to employ a movable platform for mounting the shaker units, they may be suspended by ropes so as to act as a pendulum having an extremely low-frequency resonant period When so mounted, the lengths of the ropes are such that the resonant period of the pendulum is below the lowest frequency at which the structure is to be tested and the shaker units are guyed to prevent them from tending to rotate Resonant periods in the suspension ropes and the guy ropes do occur but they are dampened out by bags of lead shot suitably placed along the length of the ropes.

A special brittle metal coupling rod is employed for connection between the armature and the structure, to prevent damage to the armature coil through lateral misalinement. It is more economical to ruin one of these mechanical fuses than to damage an armature coil

The vibration at various points on the structure under test may be measured by suitable strain-gage equipment and recorded on an electronic multi-channel recorder Such records permit accurate determinations of the stresses developed in a structure at each frequency Twelve different locations on a structure can readily be monitored simultaneously with this recording equipment, including locations that would not be accessible to an observer during a test

Similarly, in the automotive industry, the electronic exciter can be used to induce shimmying action in front wheels to see which part of the steering system will fail first, in buses, streetcars, or railroad cars it can sweep through all the bump frequencies that might be encountered on the road to see if any can induce annoying sympathetic vibrations in the frame of the vehicle, in any other structure inherently capable of shaking itself to pieces, this electronic exciter can simulate such vibration in the safety of the test laboratory, under illumination of stroboscopic flash lamps so that engineers can actually see what goes on during each phase of the test

Thus, where electronics heretofore served principally in tests aimed at

Multi-channel recording equipment on table provides permanent record of vibration effects obtained with electronic exciter

eliminating vibration in structural members, it is now coming into its own as a stimulator of vibrations Industrial applications for this new testing technique are limited only by the imagination

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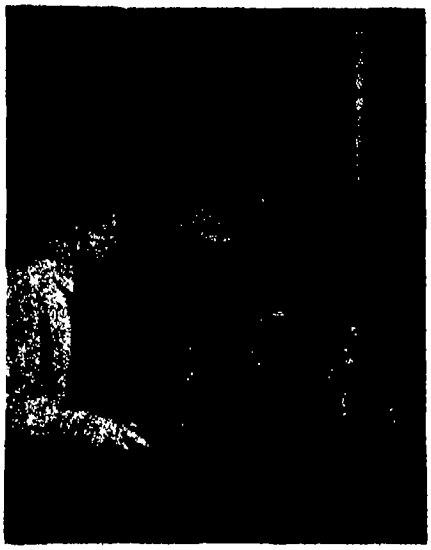
TELEVISION COLOR

Transmitted Electronically
In Laboratory Demonstration

Recently demonstrated in experimental form, all-electronic color television successfully transmitted color slides and a color movie cartoon over wires to receivers that reproduced them on a 15 by 20-inch screen in natural color The transmitter of the all-electronic system splits the scene to be televised into three colors—red, green, and blue—by means of color-separating mirrors. Each color is then fed to a photoelectric cell to convert it into corresponding electrical impulses, a feature made possible by use of a scanning cathode-ray tube as the light source for the film. The three signals formed by the impulses are transmitted simultaneously instead of in sequence as mechanical systems have done in the past



All-electronic television receiver (above) houses "Trinoscope" assembly in lower cabinet, projects images to form colored picture on screen Diagrams (below) show theory of three-channel sender and receiver

In the receiver, the three signals are fed to separate projection-type cathode-ray tubes, called a Trinescope The three images are projected onto a translucent screen so that the three colors are precisely superimposed to produce the final complete color scene, according to the demonstrators, RCA Laboratories

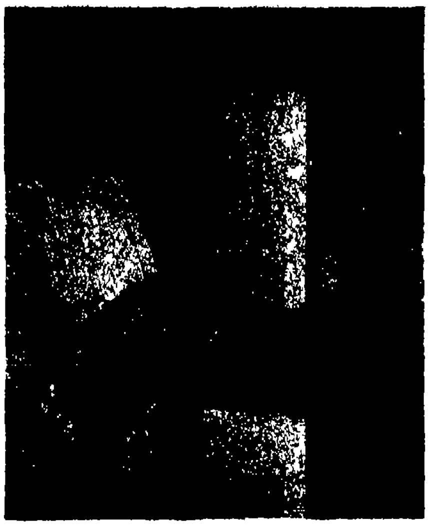
Buyers of current television receivers may, if the Federal Communications Commission establishes standards for color television based on this electronic method, use present receivers to view future color broadcasts in black and white by addition of a converter costing from $25 to $40 This converter would tune to the higher frequencies—480 to 960 megacycles—for which color-television operation is planned By the same token, buyers of future color receivers would be able to receive the present lower-frequency black-and-white broadcasts on the green channel of their color receivers However, commercial color television is not expected to have all the bugs removed until about 1950, when many of the present black-and-white receivers will be due for trade-in anyway.

HIGH-FREQUENCY STOVE

Cooks or Defrosts
Foods in Record Time

Using a radar-transmitter tube and a horn antenna, an unusual cooker, called Radarange, bakes biscuits and gingerbread in 29 seconds, cooks hamburgers with onion in 35 seconds, and grills a frankfurter and roll in eight to ten seconds A package of frozen food can be defrosted in a few seconds, and cooked almost as fast.

The equipment has the magnetron and horn assembly mounted above the cooking area, so as to beam the radio-frequency output into the food being cooked In operation, a timer is set for the desired cooking time and a button pressed When cooking is completed, the timer automatically shuts off and the food is ready to eat, according to the Raytheon Manufacturing Company The power supply is located in the base of the cabinet

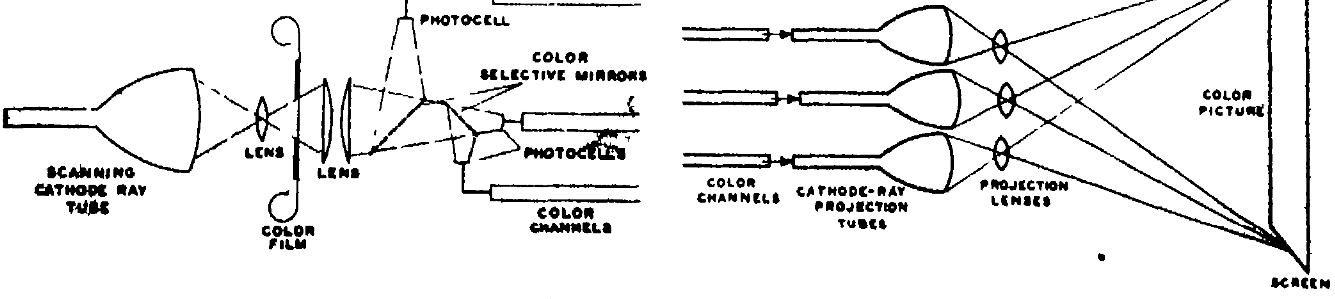


Radio-frequency cooker, side panels removed, is demonstrated on hot-dog in "oven" Cooking takes 10 seconds

RADIO PLANE TIMER

Operates Regardless of
Weather, Altitude, or Speed

Installed at two Army Air Forces speed courses, a radio-beam speedometer for aircraft employs three parallel radio beams at right angles to the charted course of the plane As the plane crosses each beam a signal is flashed to a central recording station, and the time elapsed between signals is measured against the known distance between beams to show the speed at which the plane is traveling The radio-beam system operates accurately in any weather and any altitude and is the first system capable of measuring speed at or above the speed of sound



Taking THE STRESS out of STYRENE

Annealing Polystyrene Plastics Parts Requires a Simple but Specific Technique Controlled-Cycle Water Baths and Fixed-Temperature Ovens are Practical if Results are Checked By the "Kerosine" Test

By CHARLES A BRESKIN
Editor *Modern Plastics*

As a means of preventing failure of polystyrene plastics parts due to thermally or mechanically induced stresses, more and more molders of this material are annealing their finished products The importance of this technique stems, in part, from the broadening range of applications to which styrene is being put Many molded articles are subjected to considerable abuse, sharp knocks, and so on Refrigerator freezer doors, for example, or brush backs, or mixing units for the kitchens, all commonly made of styrene, are often treated in a manner that requires them to be free of built-in stresses if satisfactory service is to be had And polystyrene sometimes suffers from erratic behavior in use as a result of stresses induced by its high coefficient of expansion—10 to 15 times that of steel Other factors affecting applications of this plastics are its low long-time strength and its susceptability to some chemicals and vapors

Because of the tremendous volume of polystyrene now being produced, assurance of satisfactory performance in consumer goods and therefore its proper annealing, has become vital to all users and producers of plastics Polystyrene was, according to figures supplied by the Plastics Materials Manufacturers Association, Inc , being made at the rate of 53,700,000 pounds per year during the first seven months of 1946 But since then many new plants have gone into operation

The increased production of this plastics material has been phenomenal during the past few years, the 1945 rate being 32 times that in 1939 And with this greater availability has gone, as mentioned above, a proportional expansion in the applications to which it is put From gadgets it has spread to the industrial, gift, fashion, and home-appliance fields It is now to be found in synthetic jewels, refrigerators, brushes, cosmetic containers, and a multitude of other end products

One of the big factors in the growing use of polystyrene has been its relatively low cost And, because of the resulting quantity that is being produced, it is in better supply than many other plastics materials although the demand-supply ratio was recently estimated at 2½ 1 In any case, the present volume of polystyrene passing through molding plants points to the importance of a wider knowledge of its annealing technology

WHAT ANNEALING MEANS — J H DuBois, in his book entitled "Plastics," has suggested an accelerated test to determine whether or not a molded styrene article will "craze," if it does, it is an indication that the piece may be improved by an annealing operation Mr DuBois stipulates that a small hole be drilled in a sample of the finished piece, followed by the application of a drop of kerosine Any tendency to

All illustrations courtesy Plax Corporation

Polystyrene disks, after kerosine test, show (left to right) proper annealing, unsatisfactory annealing, and an unannealed piece

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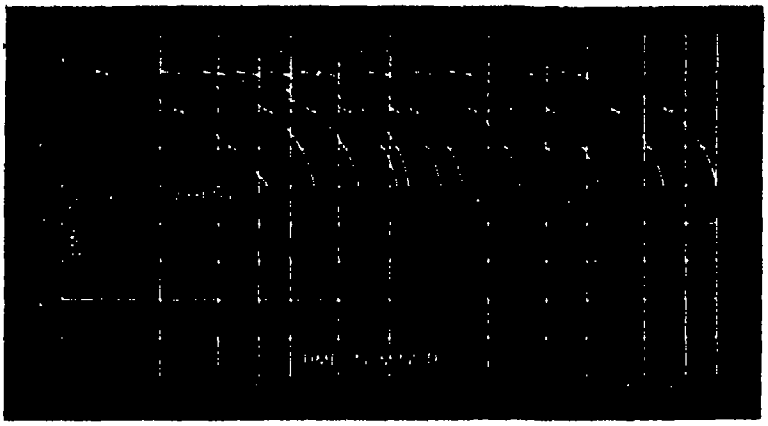
Information on the annealing operations was supplied by James Bailey of the Plax Corporation



Standard annealing cycles for round polystyrene rods (above) and for slabs of the same plastics (below) may be modified to suit actual production problems

• LOOKING AHEAD •

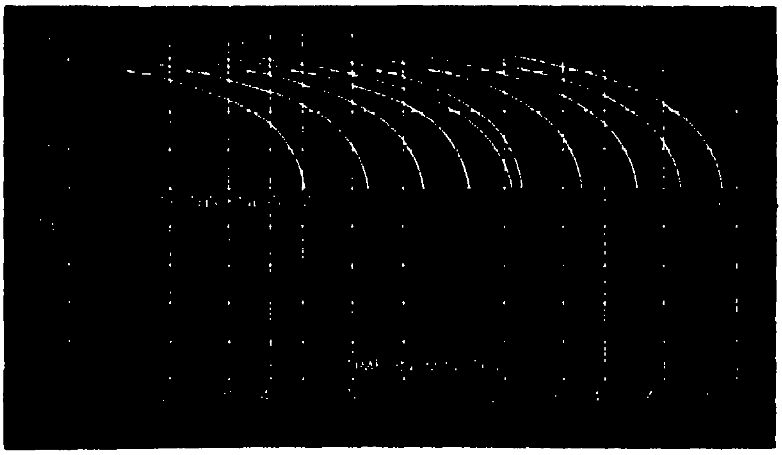
Fewer consumer "gripes" about plastics articles that disintegrate in use Application of low-cost styrene to more "quality" products when stress problems are understood Developments of faster production-annealing systems

craze will show up very quickly

The definition of annealing does not mean the same thing in all arts In the metal industry the term refers to the soft state of the material which is usually achieved by heat treatment As for the annealing of glass, there are two schools of thought The more general idea defines annealing as a cooling cycle, starting at a high-temperature stress-free state, which permits the glass to reach equilibrium at room temperature with small internal stresses The newer concept regarding the annealing of glass includes not only a condition free from mechanical stresses and double refraction but a condition in which the glass is established in equilibrium as regards its molecular state

The analogy between annealing glass and annealing polystyrene plastics is rather close, although the basic structures of the two materials are not the same Styrene differs from glass in that it has long-chain molecules with few cross links It is not truly viscous, as is glass, even at high temperatures But it does have a yield point of a sort, that is, its viscosity varies at constant temperature as some function of the speed of flow—being lower at high speeds

ANNEALING PROCEDURES—During the past several years, one manufacturer of polystyrene, the Plax Corporation, carried on a study of the annealing of this plastics. This company's annealing is



done in a water bath which is circulated by a propeller and whose temperature is controlled automatically The stainless-steel tank used for annealing is constructed with two sets of coils, one for steam to heat the bath and one for cold water to cool the tank in short cycles

According to the needs of a particular polystyrene part being annealed, the finished plastics piece is heated and then cooled for specified periods of time The cycle is established on sample annealing runs, after which a master cam is constructed which will automatically hold the controller regulating the bath to this particular cycle of heating and cooling When the end of a cycle is reached, the polystyrene parts being annealed are removed A new load may then be placed in the tank at once and allowed to heat up with the bath, or the bath may be started up and the plastics parts placed in later when some higher temperature has been reached The new charge of parts and their holding rack lowers the temperature of the bath somewhat and the cycle controller must not be started until the charge and the bath are in equilibrium.

In certain styrene parts there is a tendency toward warping because of orientation strains Rods of ¾ inch and under, for example, present this problem. To prevent this warping, the styrene may be packed in a metal-slat rack which allows the pieces very limited motion and keeps them straight during the annealing process

Standard annealing cycles for round rods and molded slabs are presented in the accompanying graphs For round rods in Figure 2 and for slabs in Figure 3 the ordinates are bath temperature in degrees, Fahrenheit, while the abscissas are elapsed time in minutes from the initial equilibrium temperature of the bath These cycles have been tested over a period of time and found satisfactory They are designed to give the shortest possible time for the required degree of annealing with a computed safety factor of two

The four parts of each annealing cycle include the holding time at 184 degrees, Fahrenheit, the initial slow cooling rate, 184 to 170 degrees, Fahrenheit, the next slightly faster cooling rate from 170 to 160 degrees, Fahrenheit, and the final slightly faster cooling rate, 160 to 150 degrees, Fahrenheit At 150 degrees, Fahrenheit, the parts are removed and allowed to air cool

With both the round rods and the molded slabs as charted, the theory is that the time required during any cycle will vary as the square of the diameter, if the stress at the center is kept constant The time for a slab four-inches thick would be four times that of a two-inch thick slab, and 16 times that of a one-inch slab A slab, incidentally, requires twice the time of a round rod of the same thickness

Working on the basis just demonstrated, any other cycle can be derived very simply if any one of the factors is known It can be seen in Figure 2, however, that the cycles for one-inch diameter rods and under are gradually lengthened over what would be required by the square law, and that the shortest cycle is for ⅜-inch diameter, with a total time of 43 minutes This departure from the formula is due to the fact that the annealing bath cannot be made to follow faster cycles with accuracy, and that small temperature lags in the cycle for less than one-inch diameter rods require a greater safety factor

MACHINED PARTS—Even in parts machined from annealed styrene stock there are problems of further annealing because of machining stresses These, however, are usually confined to a comparatively thin layer of material immediately adjacent to the machined surface Here, the annealing is merely a matter of removing the stresses in the surface layer only, no large body strains being involved

To carry out the annealing system described by the Plax Corporation, all that is needed is a simple heat treatment for a short period of time The machined parts are loosely piled in ¼-inch wire-mesh baskets to a depth of about four or five inches The basket can be of any size that will fit a small tank stirred by a small propeller Also, the basket should have a cover to prevent the parts floating out while submerged in the water bath

The loaded basket is lowered into the bath so it is covered by at least one inch of water and allowed to remain for 20 minutes It is then lifted into the upper part of the tank to a position about one inch above the liquid In this position the parts drain for 20 minutes They are then removed and allowed to cool in the air until all the parts have cooled to a temperature of 150 degrees, Fahrenheit, or below

Because water evaporates very rapidly when maintained at a temperature of 184 degrees, Fahrenheit, ethylene glycol is often added to the bath If it is used, the annealed styrene parts must be carefully washed after their treatment to remove any trace of glycol since the latter is not a very good electric insulator and does not dry readily from the plastic Swishing the baskets in several changes of water held at a temperature of about 140 degrees, Fahrenheit, will usually do the rinsing satisfactorily

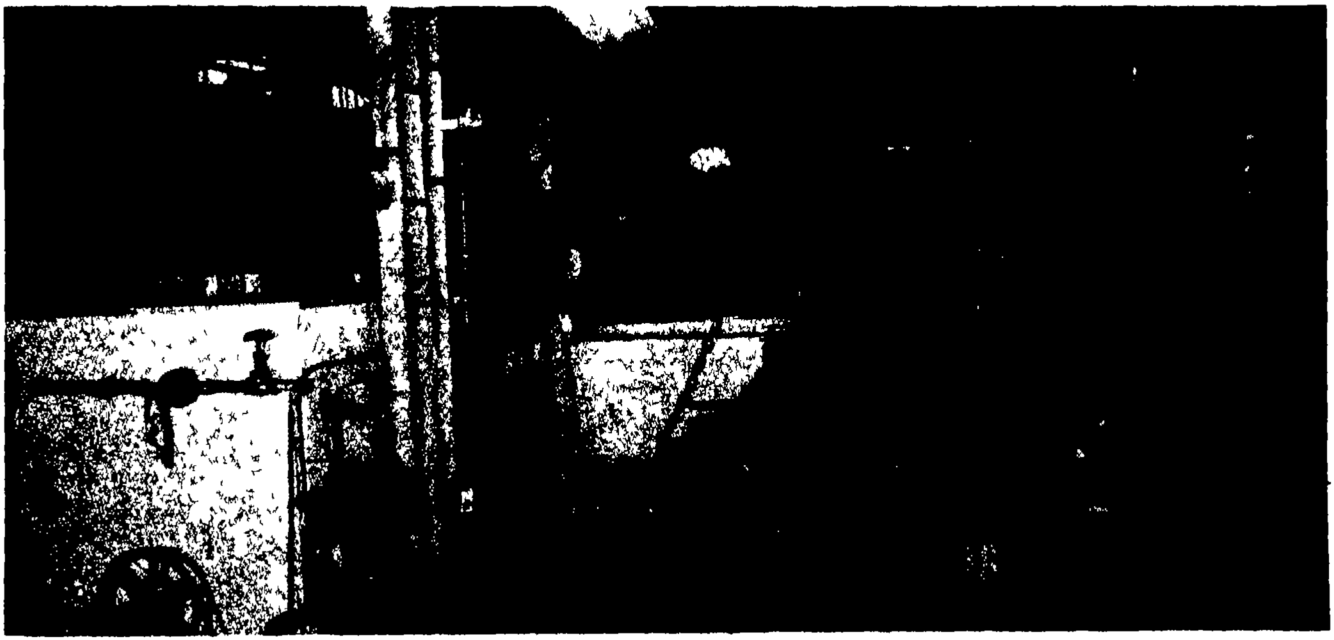
ANNEALING TESTED -- Early in the research work it was found that in order to ascertain whether or not the annealing work was being done satisfactorily it was necessary to develop a quick, easy, and reliable test of the finished pieces Consequently the "kerosine" test was worked out In this test a representative piece of the annealed styrene is immersed in kerosine for one minute at room temperature —20 degrees, Centigrade plus or minus five degrees—then removed without wiping and observed for results If the piece is free from cracks at the end of 30 minutes after its removal from the kerosine the annealing is considered satisfactory This test is applied only to such pieces as will not receive any subsequent machining

In the case of long rods which will be machined later, however, the kerosine test is applied to a crosswise sample cut from the rod at a point distant about three diameters from one end and at least ¼ inch thick measured in the direction of the original length of the rod Four small holes are drilled through the sample in the axial direction—one at the center, and the other three spaced at radial distances of ¼ of the radius, ½ the radius, and ¾ the radius from the center The exact location of the holes is not too important, and the holes themselves may vary from 1/16 to 1/6 inch in diameter

A wet saw and drills are are used in cutting out the specimen and in drilling the holes to avoid the introduction of stresses by these operations Small cracks around the ends of the drilled holes which show no tendency to spread into the main body of the material when the piece is given the kerosine test may be disregarded and attributed solely to the drilling The same is true of surface crazing along saw cuts If a sample indicates deep body cracks, even though small, when given the kerosine test, a second test is made using more care during the preparation of the sample If this piece also cracks, the annealing is not satisfactory An accompanying photograph shows a properly annealed sample, a borderline case, and an unsatisfactory annealing job

OTHER TECHNIQUES — The Bell Telephone Laboratories, among others, have worked upon the styrene annealing problem and specified a procedure for certain items In this company's specification the procedure calls for an oven treatment at a single temperature of 170 degrees, Fahrenheit, followed by cooling in still air at room temperature The maximum diameter of the part allowed for in this system is 1¾ inches, and the piece must be heated in an air oven at the specified temperature for 16 hours

The advantage of this method is that the air oven employs a simple



Annealing tank set up in molder's plant Rack arrangement holds pieces firmly to prevent warping single-temperature thermostat instead of an expensive cycle controller as with the Plax water-tank method. The temperature can be easily adjusted to some other temperature corresponding to a different plastics piece The system has the obvious disadvantage, however, of requiring 2 85 more time than the water-bath method

Mr DuBois, mentioned previously, suggests that styrene pieces which show a tendency to craze may be improved by an annealing operation in which the part is baked one hour at 160 degrees, Fahrenheit, one hour at 175 degrees, Fahrenheit, and six hours at 180 degrees, Fahrenheit. It is his opinion that thin pieces should be annealed at the highest temperature at which dimensional accuracy may be maintained 'Tests indicate that parts up to 1¾ inches in diameter will pass the kerosine test after the foregoing treatment but may suffer some unmolding

Patent literature contains other methods of annealing, many of which are quite tricky and would be rather difficult to operate on a commercial basis. Most of them are based upon a sudden change in the cooling cycle, intended to reverse the stresses due to cooling at some critical point in the cycle

The relieving of stresses in styrene by annealing should not be confused with orientation or with any considerable change in state Annealing for use with polystyrene is simply defined as the reduction of internal stresses from whatever cause to a point where the residual stresses after annealing can be borne safely by the material during its service life without crazing or cracking

* * *

WIPE-CLEAN CLOTH

Owes Properties to Plastics Finish, Does Not Glisten

There have been reports for a long time of plastics-coated tablecloths that would look just like untreated cloths yet could be wiped clean of almost any type of spot or marking with a damp rag Now such cloths are on the market and are just as practical as the forecasts promised Their introduction, and the immediate acceptance given them, opens the door to the use of plastics in a similar manner in a host of other goods Luncheon cloths, dressing-table covers, mats, and centerpieces are just a few of the applications that most resemble the tablecloth in use

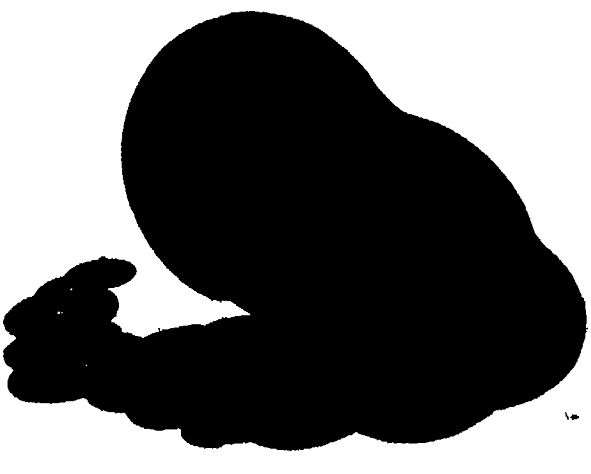
The easy-to-clean feature of these tablecloths is imparted by a thin, almost invisible coating of Monsanto vinyl butyral Tough and flexible, there is no shine to the coating, a characteristic resulting from the inclusion of finely divided, sub-microscopic silica particles which scatter light waves instead of reflecting them This coating can be given the cloths at a very small increase in cost, and one which will quickly be wiped out by the saving in laundry bills The coating is applied to but one side

The Monsanto Chemical Company, who first announced these cloths, is the supplier of the vinyl butyral Also, it supplies the technology on the application of the finish The coating is for mill application only

PLASTICS-BONDED ABRASIVES

Matched to Operating Conditions, Precisely Sized

For the deep-grooving of metal, grinding wheels have been developed in which Durez resins are used to bond the abrasive particles to the wheels So that the wheels will be able to meet all types of operating conditions, the phenolic resins have been specially formulated to match the size grain of the abrasive used, the temperature necessary for bonding, and the pressure used in the process The wheels are supplied in many sizes, grains, and grades, and have a guaranteed tolerance of plus or minus 0 005 inch, according to the developers, the J G Sandstrom Grinding Wheel Company



Wide selection of sizes, grains and grades, makes these precision-type wheels adaptable to many jobs

KNIFE SETS

Produced of Special Wood

Resin - impregnated compressed wood, which gave a good account of itself during the war in airplane propellers, has started to make its appearance in domestic products Uses include holders for kitchen and table knife sets such as those produced by Adams Plastics Company from Compregwood

Useful compressed-wood articles

REFLECTING PLASTICS

Make Night-Visible Signs By Small Molded-In Lenses

House signs that show up at night are not new, but a street sign that is as easy to see by night as by day is a welcome innovation And that is the latest use which has been worked out for an acrylic sign material called Reflexite

The ability of these signs to show up clearly is a function of thousands of minute lenses which are molded into one side of thin transparent Lucite sheets There are about 2500 of these lenses to each square inch of plastics surface The back of each sheet is polished smooth, acting as a focal plane of the molded lens areas on the other side Reflecting characteristics are determined by the thickness of the acrylic pieces

Individual letters are applied to the back of the acrylic piece by silk screening with a special acrylic ink containing aluminum powder The background color—any color—which provides contrast is then applied.

The completed sign is made by forming a metal or other suitable support for the letters which are to be combined The letters are held in the holder by an adhesive

Lifting electroformed antenna masts from tank, tapered matrix can now be removed

ELECTROFORMING for Precision

When Production Quantities of Accurately Contoured Parts are Needed, And Finishes are Specified in Micro-Inches, the Answer May Be Electroforming Unusual Metal Density is Added Feature

By H R CLAUSER

Associate Editor *Materials & Methods*

Something new in metal parts production methods entered the industrial picture with the development of the Ekko process for producing rubber-tire molds by electroplating Here, a thick film of iron is plated on a suitable matrix Separating the matrix from the electrodeposit gives an accurately and intricately shaped tire mold possessing excellent finish, long life properties, and attractive economy as compared with conventional tire mold making methods.

During the last few years the same general technique, called electroforming, has been applied to a wide variety of other types of parts, often using other metals than iron Many plants outside the tire industry came to use either the products or the process itself Now, electroforming has emerged from this development period as a highly promising method of making certain types of precision metal parts.

Electroforming is actually an extension of electroplating But decorative or protective plating generally involves deposits of metal of only about .0001-inch thickness on previously formed parts Electroforming, on the other hand, is principally concerned with the primary shaping of a part by the build-up of electrodeposited metal on a mold or matrix

In a typical application a die or mold is made from a master pattern of the part to be formed This mold is termed the matrix It is a negative impression of the finished part and serves as the base for electrodeposition of the metal The matrix is placed in an electroplating bath where the form of the part is built up by electrodeposition After the metal has been deposited on the matrix to the required thickness, the plated matrix is removed from the bath and separated from the electrodeposited metal The resulting electroformed part is an exact duplicate in metal of the master pattern

MATRIX TECHNIQUES—The making and use of the matrix is probably the most important step in the electroforming process Three different techniques are possible One of these makes use of matrix material with a melting point of 200 to 500 degrees, Fahrenheit, bismuth-lead alloys are the most widely employed After the deposited metal has built up to the desired thickness, the matrix is melted away from the electroformed part.

Another technique makes use of a steel mandrel as the base for the electrodeposition of the metal. The mandrel is machined or ground to

Electroforming can produce intricate pieces almost impossible to machine Computing cam (above) and angles and tapers (above right) are typical The radar feed horn (right) required an interior smoothness and accuracy that proved unobtainable when using conventional sheet metal structures

the shape, dimensions, and finish desired Because parting compound is used to prevent the locking of the mandrel to the electrodeposited metal, the mandrel is made from 0002 to 001-inch undersize A wide variety of parting compounds can be used these include thin films of low-temperature melting metal, such as tin or cadmium and films of wax or lacquer

The mandrel method can be used for any part whose shape permits the mandrel to be withdrawn from the electroformed part Depending upon the design of the part, one or several mandrels may be used When more than one is used, they are interlocked in such a way that each can be drawn independently

To separate the mandrel from the part, heat is first used to melt the parting-compound film, then pressure is applied and the mandrel is forced away Because the same mandrels may be used to produce a quantity of the same parts, they are usually made of hardened steel

A third method is the use of a soluble matrix The technique is essentially the same as that for the low-temperature melting matrix The matrix can be made of any material that will not attach itself to the electrodeposit and which can be dissolved by an acid or an alkali Materials which have been used successfully include aluminum, zinc, and magnesium

All three of these techniques have distinctive characteristics which suit them to particular types of electroforming work The steel mandrel and the soluble-matrix methods are applicable to very close tolerance jobs and to applications where extremely high surface smoothness is required Parts accurate to within 0004 inch are attainable as compared to a 004-inch range possible with the low-temperature melting matrix method

• LOOKING AHEAD •

Parts electroformed from a wider range of metals Greater use of remarkably dense iron deposited by this method Substitution for expensive machine-contouring in some cases More metal-covered plastics

The low-melting matrix method is the cheapest of the three, while the soluble-matrix technique is used only in designs where steel mandrels are not adaptable because of the shape and complexity of the part, and where the desired tolerances and finish cannot be achieved by the low-temperature melting matrix procedure

FORMS UNIQUE METALS — At present, the metals which can be electroformed most practically are iron, copper, and nickel Chromium can also be electroformed, but is used only where high hardness and abrasion resistance are required. To meet special surface requirements, however, any of the regular plating metals may be plated on the electroformed part.

In some cases parts have been built up by electroforming several laminations of different metals on the matrix So far little advantage has been demonstrated for this method of electroforming because of the extra operations and the care required Ordinarily, a satisfactory part can be produced with somewhat less effort using a single material

Of the metals applicable to electroforming, iron is the most widely used Because of its unique characteristics, electroformed iron might justly be considered a new engineering material Electroformed iron is 99 8 percent pure In the as-electroformed state the iron has a hardness of around 250 Brinell and a tensile strength of 50,000 to 55,000 pounds per square inch In the fully annealed condition the hardness drops to around 140 Brinell, but there is no change in the tensile strength and the ductility increases as indicated by an increase of 10 percent in elongation

A significant characteristic of electroformed iron is that it approaches absolute density The virtual absence of porosity is evidenced by the fact that, on a vacuum test that has been running for several months, a sample of electroformed iron has proved to be less porous than a piece of glass submitted to the same test

In its weldability and heat-treating characteristics, electroformed iron is similar to low-carbon steel Its machinability resembles that of brass, although it is harder and tougher than cold rolled steel The tool settings are about the same and the shavings have the stringy appearance generally associated with machining brass

GREAT ACCURACY — The two outstanding characteristics of electroforming are the extremely high surface smoothness attainable and the very close tolerances to which it can work There is almost no limit to the surface smoothness or the dimensional tolerances possible These two characteristics of finish and tolerances are almost solely dependent upon the matrix quality It has been pointed out previously that tolerances on the order of .0004 inch are possible Surface finishes around five micro-inches are easily obtainable, there have been applications in which finishes with a value of two micro-inches were achieved No additional finishing operations are required to secure these extremely smooth surface finishes, they are inherent in the electroforming operation

Another important characteristic of the electroforming process is its ability to produce accurately and economically parts having very intricate or minute details An example of this is found in computor cams for artillery-ranging devices Producing parts such as this, with hundreds of projections—each one placed slightly different—would be a tedious and costly job by machining methods, only by electroforming can quantities of the part be produced at reasonable speeds

Electroforming can be employed for parts with sections up to ½-inch thick but there is almost no limit to the thinness of section which can be formed Parts of electroformed foil 00008-inch thick have been produced successfully Further, there are no definite limits in size of parts possible The maximum dimensions are limited only by the size of the tanks available for the electroforming operation

As for shapes, the process is most applicable to parts with flat contour shapes and to tubular or hollow products There are practically no restrictions as to cross-sectional designs in tubular products, tapered, round, rectangular, elliptical sections, and so on, can all be electroformed There is one limitation to be observed in electroforming parts with recesses in the design Metal cannot be effectively electrodeposited in recesses which are deeper than they are wide

While electroforming is a high-precision metal forming method, production costs are relatively high It cannot compete with other processes in the mass production of parts where the tolerances are large or moderate and where high surface smoothness is not required There is possibly one exception to this In small-quantity production it will compete with die casting

MEETS SPECIAL NEEDS — Electroforming has a set of virtues which fit it best for certain specific applications in the field of metal forming Examples of such applications include parts requiring an extra high surface finish, especially where that finish is required on internal surface contours such as tubing, flow and venturi nozzles, and complex bends and elbows as found in radar antenna and horns; high-precision parts in which tolerances on the order of 004 inch and less must be met, and products that require absolute accuracy of shape or form. Examples of the latter are wave-meter cavities for radar work in which adjacent interior faces must be absolutely normal to each other

Electroforming is also an answer to problems involving parts having intricate details which cannot be made by any other method or which would otherwise require hand or extended machining methods Typical products in this category are computing cams for calculating machines, surface roughness comparators, and heat exchangers Other applications of this method extend to parts where the quantities required are too small to use die casting, economically to resizing and coating applications such as electrodepositing metal on plastics for improving the plastics' properties, and to building up of worn machine parts

In comparison with other metal-forming methods, electroforming can do some things that the others cannot do, at the same time it cannot match some of the others in certain specialized respects Thus it supplements and extends machining practice Electroforming has sometimes been called "cold casting" because it competes with casting, but does not require allowances for shrinkage in the pattern work Electroforming, however, lacks casting's versatility with respect to alloys, and suffers from certain design limitations And, in competition with sheet-metal forming methods, electroforming must definitely be considered for such parts as reflectors, propeller blades, and so on, where internal surface contouring is required in conjunction with high accuracy and surface smoothness

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"SUPER-ALLOY"

Promises Unusual Results
In Brass-Casting Dies

THE SPECIAL 16 chromium, 25 nickel, 6 molybdenum alloy steel developed and extensively used for stressed parts of gas turbines and turbo-superchargers operating at temperatures up to 1500 degrees, Fahrenheit, has been used in the construction of dies for die casting of brass

Results to date are described as "spectacular" Previously, with standard die materials, short life and high cost made for small use of brass die castings. If the Timken 16-25-6 "super-alloy" turns out to be "super" for brass die castings it might prove to be revolutionary in that industry

PHONE LINE SHEATHS

Made of New Alloy
For Better Cable Protection

AN IMPROVED lead alloy has been developed for the flexible tube that stretches from one telephone pole to another, enclosing a group of wires It is an arsenical lead, containing small amounts of tin and bismuth and is suitable for underground installations as well as over-head suspension

The sheathing is characterized by strong, tough welds, outstanding resistance to bending fatigue, and excellent creep resistance and bursting strength A successful cable, it is said, depends more on the sheath than the insulation

CHROMIUM-BASE ALLOYS

Seen Promising for Turbo,
Jet-Engine Applications

ONE OF the most interesting results of the nation-wide search for new and better high-temperature alloys for jet engines and gas turbines is the development of chromium-base alloys to be used for such purposes

Two such alloys, one containing 60 percent chromium, 25 percent molybdenum, and 15 percent iron and the other containing 60 percent chromium, 25 percent iron, and 15 percent molybdenum, were developed by metallurgists of Climax Molybdenum Corporation and are still considered in the experimental stage Work on them is now being carried on under government sponsorship at Battelle Memorial Institute Although these alloys have the highest stress-rupture properties at elevated temperatures of all the 'super-alloys developed for high temperature use, their utility for other applications is impeded by their brittleness

Successful production procedures for the chromium-base alloys include vacuum melting and pouring to eliminate oxygen, nitrogen, and other gases and their compounds, from the metal Although the alloys are expensive, their perfection as practical, serviceable high-temperature materials, if achieved, will certainly lead to their use in small amounts for certain turbo or jet-engine parts where the utmost in high-temperature properties will pay handsome dividends in operating efficiencies

Apprenticeship vs Mechanization

Damned by Some and Praised by Others, the Old Apprentice System Had Much in Its Favor—For Those Times and Machines Modern Equipment Does Automatically Much of What Apprentices Learned to Do by Skill, Efficient Training Now Takes Days Instead of Years

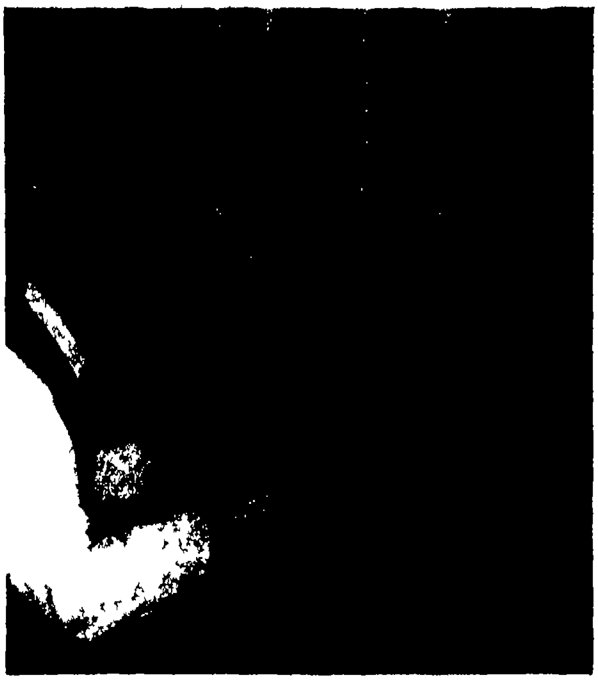
By EDWIN LAIRD CADY

BACK in the 1880's when the apprenticeship system was at its height a young man named Schatz entered a *Machinefabrique* (machinery manufacturing plant) in Weingarten Wurttemberg His sons tell about his career

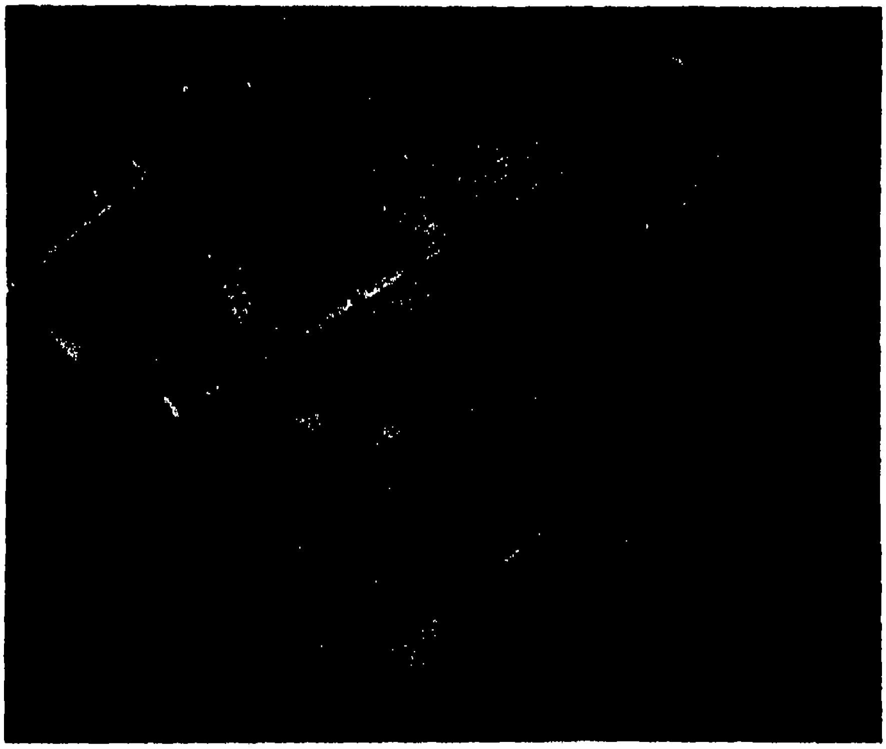
Schatz signed an indenture which promised him small amounts of money but large chunks of hard work There were two periods his papers said at which either he or the shop could cancel that contract One was at the end of six weeks the other after a subsequent six months If he outlasted those two periods he had to stick and the shop had to keep him

During those first six weeks he just walked around the shop making up his mind whether or not he really wanted to learn the machinist's trade He saw how hard the men worked, observed how industrial accidents happened and how painful they were, listened to the kicks of the well advanced apprentices More than one boy who started with him decided that he would rather be a barber or a brick layer

Long years were spent in developing skilled hands of old school" tool maker (right) This man maintains precision gages for thousands of the modern "specialized' workers. Simple tools and specially rigged lathe (below) make long training of operator unnecessary, but machine designers are highly trained men



Courtesy Fairbanks Morse and Company

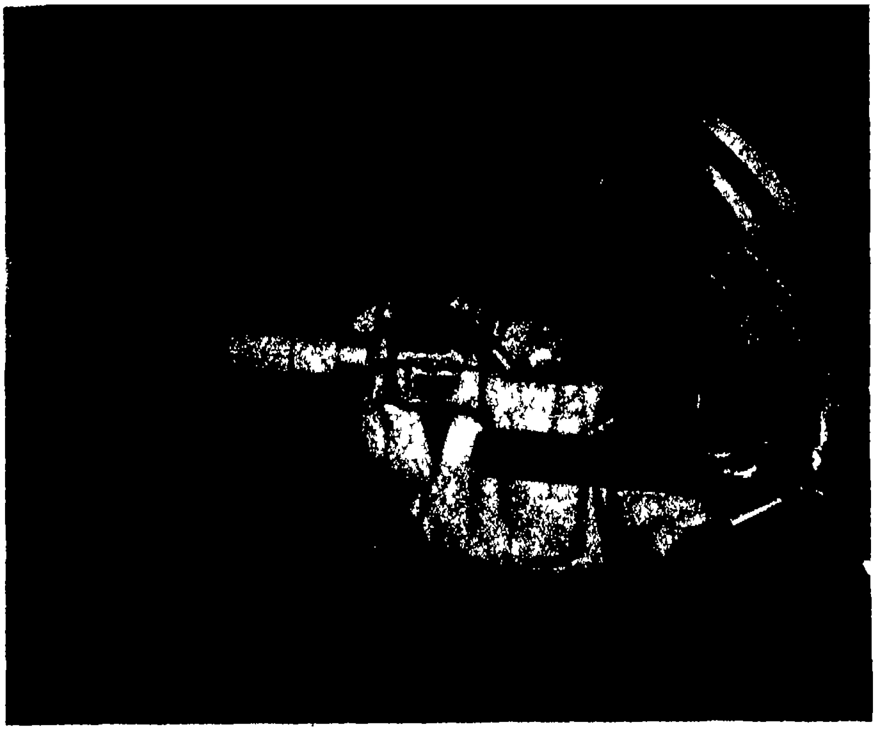


Courtesy Machlett Laboratories

After that six weeks young Schatz was given a bench a vise and a drawer full of files He had to get that bench and vise level and square A clout on the head from the foreman was his punishment if his equipment got out of level or square or if any of his tools were not kept in order

Next he was given several pieces of steel. He could have all of these he needed There were round bars square bars, flat pieces with round holes and with square holes in them

In his drawer was a full equipment of files They were of at least a dozen shapes, sizes, and grades He was shown how to grasp a file by the handle with his right hand and



Tube sealing job demands great care but no knowledge of prior production steps

by the tip with his left and, bending the file so it made a slight arc, to start the stroke with a very light pressure against the steel and to keep the stroke perfectly steady and straight With time, a file became like a musical instrument in his hands

By the end of six months the apprentice was required to file a round hole into a square one, file a round bar into a square shape, and get them both so closely to the same size that the bar would pass smoothly through the hole but be light-tight all the way He also had to file a square hole to a round shape and a square bar to fit it He spoiled plenty of steel before the foreman could pass each bar through its fitted hole and not see daylight between them

Schatz worked at this for six hours a day, six days a week, for nearly six months He went to school for another four hours a day

ALL-AROUND STUDIES — His studies were to last throughout the four years of indenture They included something of a general education, and a great deal of physics, chemistry, geometry, and algebra But most of all he learned the exquisitely accurate mechanical drawing which his company used at that time

Few modern engineers ever have seen such drawings. If a machine were three feet square by four feet high then the drawings for it made a pile three feet square, plus margins, and four feet high. That pile could be separated at any point and right there would be a complete plan-view cross section of the machine at that point, all worked out in colored inks, with working speeds and the materials of all parts plainly shown

Obviously, drawings like that could not be made for every device The apprentice learned how to make free-hand sketches from the most meager of descriptions, and how to visualize and produce complex parts when he had no sketches at all And he went on to learn how to operate every machine and process in the plant

A young man so trained would never disrespect his own person nor any good machine or tool throughout his life His fellow apprentices at Brown and Sharpe in the United States, and in other shops all over the world, were following much the same courses of study Character building came first with their teachers, working skills second They were in every known trade And they were to flood the world with factories Schatz himself founded the company which later became the Federal Bearings Company

Compare all this with what would be most likely to happen if the same young man were to enter a large American factory today

He would not stand around for six weeks just finding out whether he was likely to be happy at his work or not An expert personnel counselor, highly trained in industrial psychology, would tell him that.

No foreman would hit him on the head for failing to keep his hands and clothes clean and his hair combed, nor for any other reason whatever He never would know whether or not his equipment was in or out of level and square The chances would all be against his handling a file for any but very minor operations, one can walk through hundreds of machine shops today without ever seeing a man who really knows the art of filing Today's young factory worker would never make or see a blue print unless he became either a foreman or a draftsman Not only would he never learn what every part of his machine is and how it works, but probably there would not be any one man in his entire department who knew

• LOOKING AHEAD •

No return to prolonged apprentice training plans. . Further use of "machines that think" in fields still dependent on slowly acquired skills . . Establishment of more vocational training schools for industrious individuals Expansion of varied training programs for ambitious seekers of key industrial positions,

SPECIALISTS TODAY — From his first minute he would begin to be a specialist on some one kind of work There would be other specialists all around him, and he would depend upon them Even if he showed such mechanical aptitude as to be trained as a tool maker he would not find every man doing all of his own work as used to be the case Rather, the tool room would have lathe experts to do all or nearly all of the turning for the tool makers, and beside them would be filing-machine men, band-saw men, welders and brazers, and heat-treatment specialists

The training of the new man would be by personal instruction, and if his job were difficult, by motion pictures and still pictures

A motion picture would show him a skilled operator at work on that task With his foreman or other instructor at his elbow the new man would be encouraged to run that picture for himself, reduce it to slow motion so he could see everything the other man did, even run it backward Later on a motion picture might be taken of himself at work, and he might be encouraged to go all alone into a projection room and compare his "movie" side by side on the screen with that of a man more skilled than himself On less intricate or complex jobs a series of still

Operator s little knowledge of her expensive machine Automatic con trols, however, would prevent serious damage if she should make a mistake

pictures would do all of this for him

Time-and-motion study men would help his foreman to teach him Within five days or at the most a few weeks he would be a reasonably skilled operator at his job And under a modern incentive system with every increase in skill would come an automatic reward in higher pay

Employee selection and training systems like these took millions of completely unskilled men and women during the war and turned them into the most effective labor force ever known to industry They proved that—with modern mechanization of almost every process, the modern way of putting the brains into the machine design instead of requiring them of the operator—the old conception of apprenticeship training for machine operators has gone by the board

In spite of this, the fundamental philosophy of apprenticeship is not obsolete All that has changed is its application

BASIC FOUNDATION — When young Schatz began his work he was given a foundation He was not required to make his own files or to roll his own steel It was taken for granted that others could do this better for him Their work was the foundation upon which he began

The problems of machine-tool design and of the functionings of machine parts have similarly been worked out for present-day beginners Young Schatz worked with machines made of simple and comparatively weak gears, wheels, levers, slides, and structural members He had to be careful about how he handled them The modern beginner works with strong, electrically controlled, highly protected machine tools which are designed to withstand almost anything that a human being can do to them and to be proof against almost any false motion that a reasonably well-instructed operator might make Standing upon the foundation of such machine design there is no real need for the beginner to have any deep understanding of the machines he runs

Young men who are able to start today with the modern machine basis and go on through what amounts to an apprenticeship, are college trained or else have spent long hours in night schools and in self education Also they have to spend at least four years in preparation and to work long hours just as Schatz did It is a rare engineering-school graduate who gets through on less than 70 hours a week of lectures and study And the shop man who puts in his 40 hours a week at his machine and then goes to night school for 15 hours more will certainly hit the 70 hours a week mark by the time he gets his studying done

Thousands of leading industries are picking up college men and self-trained men and putting them through shop-wide or entire company-wide courses which are highly parallel with the training given to old time apprentices International Nickel does this and Aluminum Corporation United States Rubber, Bryant Chucking Grinder Standard Oil of New Jersey, General Motors, and Carbon and Carbide Chemicals, to mention only a few Like the apprentices of old, the survivors of these training courses are expected to find their specialties and become the leaders of the future

EDUCATION CHANGES — There was a time when in some industrial towns a grammar school diploma was a sufficient certificate of preparation for apprenticeship In many towns, up until about 1905, a grammar school education included a few months of physics, elementary descriptive chemistry, physiology, plane geometry, and simple algebra, all of which an apprentice might need In many a New England mill town the primary school curriculum included teaching little fingers to tie weavers knots Now the grammar school is mere preparation for high school and little fingers do not need an apprenticeship in weavers knots which are much better tied by machines.

Before the war it was believed that arc welding needed a long apprenticeship But during the war thousands of arc welders were trained, and in very little time

Here and there are industries in which the old apprenticeship system still is needed Foundries are an example It takes time to learn how and when to pour hot iron so it goes straight into the down sprue and entraps no air and when to use a swirling motion which slows down the flow for better progressive solidification and permits the entrapped air to escape via the open risers But even so the apprenticeship does not need to last four years nor any other fixed period of time

Modern training of employees does not ordinarily require the devotion of any great amount of time to schooling Efficient educational methods, well developed training aids, and the great mechanical perfection of the machines themselves obviate many of the laborious learning processes once thought essential The nostalgic yearnings of some of the old timers for the return of the apprentice indenture system will be satisfied in only a very few instances For those men who show a real desire to progress and learn, however training courses equally arduous and highly similar to the old-time methods are still open and in many cases represent the pathway to the top

* * *

BETTER FIRE BRICK

Step Up Furnace Production, Save on Fuel

At the National Bureau of Standards and by agencies co-operating with the American Society for Testing Materials thousands of tests of fire brick have been made Good books on refractories and their chemistries are rare and most developers of fire brick have had to follow paths which were but poorly charted, and it is only by standard testing and patient development that they have gotten such results that forging furnaces lined with brick can now be heated up in 35 minutes as compared to a previous 210 minutes, with a fuel consumption for heating-up reduced more than 80 percent, and that the number of pieces heated for forging per working hour is up more than 40 percent

A New Diet For Diesels?

The Slow-Speed Predecessors of Today's Ubiquitous High-Speed Diesels Could, and Often Did, Burn Almost Anything Now the Sound and Fury of Diesel-Fuel Evaluation is at a Peak As Usual in Such Cases, the Answer is a Compromise of Technical, Economic, and Practical Factors

By MARSHALL J WATERS
Shell Oil Company Inc

• LOOKING AHEAD •
Continued growth and extension of Diesel applications Better performance with reduced smoke and smell Cleaner engines, lower maintenance cost Greater care by users on matching of fuel to specific engines

MODERN high-speed Diesel engines have evolved over a period of many years from the early slow-speed stationary and marine engines Diesel engines were developed originally with the thought of burning powdered coal and theoretically, at least such engines could be produced For various practical reasons, however, petroleum fuels are thus far used exclusively and their availability has permitted the progress of the Diesel to the position it occupies today

Fuel problems are comparatively simple in the large, slow-speed units Generally, these will burn satisfactorily any clean fuel which has sufficient lubricity to protect the fuel pumps and injectors, and atomizes properly when sprayed into the cylinders Many such engines operating at speeds of 100 to 300 revolutions per minute, have satisfactorily burned heavy, viscous bunker fuel oils, heated to facilitate pumping and atomization

Unfortunately the fuel requirements of high-speed engines—those operating at speeds in excess of 800 revolutions per minute—are not so easily met The reasons for this are several, the most important being the small combustion chambers, the extremely short time available for injection and combustion, the smoothness and flexibility required, and the need for minimum smoke and odor The last named factor has recently assumed great importance in truck, bus, and railroad service where the majority of high-speed Diesel engines are used In fact, some municipalities have passed ordinances limiting the smoke output of Diesel engines used in highway transport service

FUEL PROPERTIES EVALUATED— An examination of the properties which affect service performance in high-speed Diesel engines brings out the fact that although fuel specifications consist of an imposing array of laboratory tests, only a few of the properties evaluated have any real significance insofar as performance of the fuel in an engine is concerned Flash point, for example, is of value only in demonstrating the safety of the fuel in handling, pour point indicates the lowest temperature at which the oil will flow, ash, water, and bottom-settling-and-water tests all indicate the degree of cleanliness—admittedly a most important point in any Diesel fuel The carbon-residue test is useful mainly in detecting the presence of heavy residual components which are undesirable in high-speed fuels

From the performance viewpoint the most significant properties are gravity, volatility, viscosity, and cetane number These have been investigated by the Coordinating Fuel Research Committee as represented by several engine manufacturers and petroleum refiners, and their findings were published in the *SAE Journal*, March 1945

The American Petroleum Institute gravity of Diesel fuel is an important yardstick in determining fuel economy and power Although low-gravity fuels have a somewhat lower heat content per pound, their greater weight per gallon results in increased heat content per unit volume and thus greater potential energy per dollar It also results in better economy and increased power output, since a given volume of charge injected into the cylinder contains a greater heat content when low API-gravity fuels are used

Viscosity and volatility must be considered together since they are inter-related The CFR committee found that less viscous and, correspondingly, more volatile fuels gave cleaner combustion (less smoke) and less deposition in high-speed engines Excessive volatility can cause rough running in certain engines, however, so this property must be carefully controlled by the fuel supplier Also, less viscous fuels normally give poorer economy than the heavier ones

The fuel viscosity permissible for use in Diesel engines has been made the subject of intensive study The maximum viscosity is usually controlled by factors such as distillation range On the other hand, if the

Carbon deposition on injection nozzle Six carbon horns can be seen projecting from orifices Fuel passed through channels in horns but spray characteristics were unsatisfactory Carbon forming is but one of many Diesel fuel factors fuel is kept clean, fuels having a viscosity as low as 32 second Saybolt Universal at 100 degrees, Fahrenheit, appear to be satisfactory from the standpoint of pump and injector wear. Increased viscosity provides some protection against abrasive wear due to dirty fuel but cannot eliminate it. Fuels must be kept clean!

The viscosity and volatility of fuels are closely controlled by the refiner to give optimum performance in the intended service.

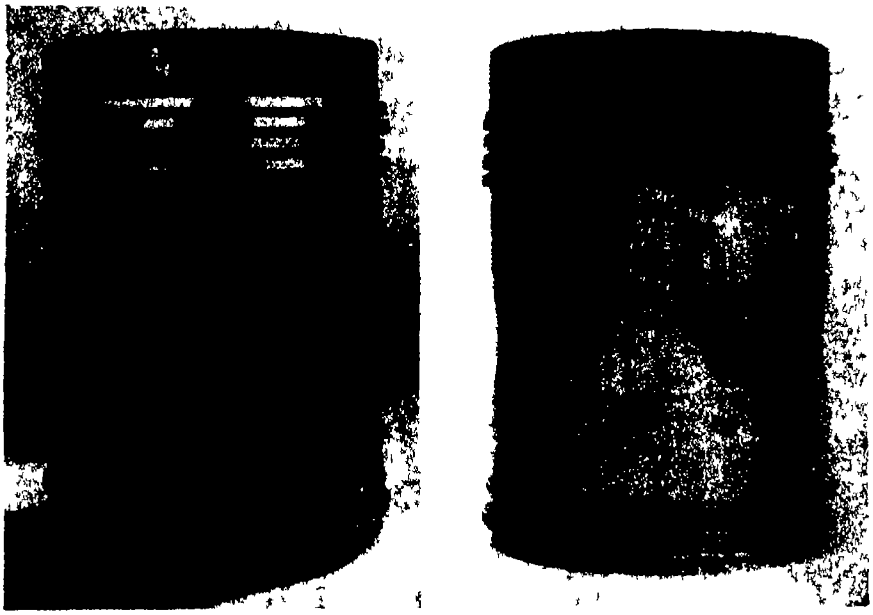
IS CETANE IMPORTANT?—In recent years, the general lack of understanding of the real significance of cetane number has resulted in undue emphasis being placed on this property. This has had the direct effect of increasing production costs and restricting the potential availability of otherwise satisfactory fuels. Cetane number is a measure of the ignition delay or lag which occurs when a fuel is injected into the cylinder—the length of time which elapses between the time of injection and the start of combustion. It is dependent largely upon the chemical composition of the fuel. In the practical engine, a small delay is desirable for maximum production of power and the permissible delay is also a function of engine speed. Hence, there are so many factors involved that only an actual trial will determine the suitability of a given fuel in a given engine. Cetane number is certainly not the answer.

In blending Diesel fuels for high-speed engines, the petroleum refiner is limited by the quantities of suitable stocks available. In the past, Diesel fuels have been prepared largely from selected intermediate gas-oil cuts obtained from the distillation of crude oil. This fraction also supplied domestic heating oils. The lighter fractions of the crude went into the manufacture of gasoline and kerosine, while the heavier cuts were used for lubricating oils, residual fuels, and so on. As gasoline requirements increased, thermal cracking came into extended use, converting heavy residue and some gas-oil into gasoline, cracked gas-oil, and heavy fuel oil. More recently, catalytic cracking has been generally adopted and has provided a very definite drain on the supplies of straight-run gas-oil. In addition, new offtakes for intermediate oils are being developed, the most striking at the present time being the growing demand for fuel for gas turbines as typified by the jet engine for aircraft use. Fortunately, among the products of cracking are gas-oils which, with proper treatment, are well suited for use in Diesel fuels. The main difference between these and straight-run gas-oils from the same crude is a somewhat higher cetane number for the straight-run material, although it is not uncommon for cracked-gas oil from one crude to have a higher cetane number than straight-run gas oil from a different crude.

BALANCED FUELS—In any case, for the high-speed Diesel engine it is necessary to balance all properties in the fuel rather than try to obtain just a high cetane value alone. To incorporate such balance in the finished fuel it is necessary to compromise and consider all the chemical and physical properties which affect engine performance.

Viscosity is controlled to give fine atomization at the injector nozzles, yet still provide good lubrication of the fuel-pump plungers. Volatility is limited to the fractions giving rapid and complete evaporation once the fuel is injected into the cylinders, without the risk of vapor lock occurring between the fuel pump and injectors. Ignition quality is made as high as possible for the whole of the fuel—not merely the most volatile part which evaporates first. Heat value is maintained as high as possible to give the maximum amount of power from every gallon of fuel, thereby reducing the fuel consumption. Flashpoint is maintained high enough to reduce fire risks in the fuel storage system. Pour point is kept to the lowest possible value so as to eliminate sluggish flow or restriction to the fuel pumps in winter time. For completeness of combustion and absence of carbon deposits in the engine, the high-boiling-point fractions must be limited and the ash kept to a minimum. Finally, in view of the close fit of the fuel-pump plungers and injector parts a good filtering system is always incorporated in high-speed Diesel engines and this necessitates the fuel being supplied clear, clean, and free from all impurities.

Dirty valve (above) and piston (below) compare with relatively clean valve and piston to demonstrate the importance of selecting proper fuel for a given engine



The engine and fuel industries are continuing their co-operative studies of requirements for the purpose of adapting the engine to the fuel, as well as the fuel to the engine. This must inevitably result in furthering the spectacular development of the Diesel engine and deeply entrenching its position in our national economy.

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PREMIUM OIL

Cleans Engine, Keeps It Clean, Improves Performance

Highly refined, a new treated lubricating oil to which certain patented ingredients which increase its usefulness have been added, has recently been placed on the market. It is made by taking a choice fraction of selected crude and extracting all but the most desirable constituents. The refined base stock is treated in various ways to improve its purity, and the several new ingredients are then added in relatively small amounts but with major effects on the properties of the oil.

The resulting motor oil has all the basic properties considered desirable in any good lubricant, including the ability to reduce friction between moving parts to a minimum. In addition, it is claimed, it has the special capacity to protect against varnish deposits on pistons, cylinders, and other vital engine parts, against sludge deposits, against bearing corrosion, and against deterioration or breakdown of the oil itself.

These four capacities are prime requisites in any motor oil meeting the "premium" standards established by the American Petroleum Institute. The new oil, called Permalube, has certain other characteristics which its developers, Standard Oil Company (Indiana), call "plus properties." As claimed, these are that it cleans engines and keeps them clean, is superior in lubricating during the break-in period of a new or reconditioned engine, assures easy engine starting and ready lubrication of frictional surfaces, protects unusually well against engine wear, reduces ring sticking, keeps oil consumption to a minimum, shows a minimum of carbon formation in cylinder combustion chambers, increases the effective life of oil filters, helps to solve the problem of water sludge, and protects against the difficulties caused by foaming.

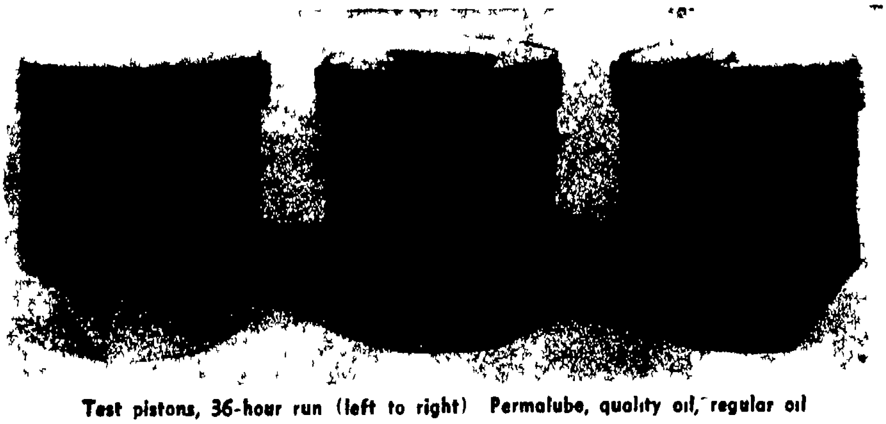
After loosening engine deposits of soot, carbon, varnish, and sludge, the particles are held in suspension so they cannot pile up into masses of sludge which may block vital passages. Instead, they are dispersed in the oil and drain out when the oil is changed. With regular use, the new oil will gradually clean an engine and keep it clean.

COLD-WEATHER FUELS

Start Aircraft Engines Without Pre-Heating

Problems involved in starting aircraft engines in sub-zero temperatures have long troubled the aviation industry. In sub-zero weather, ordinary aviation gasolines will not start aircraft engines. These gasolines cannot be permitted to contain the light ends or low boiling fractions—necessary for cold-weather starting—because of the dangers of vapor-lock in flight. Therefore, elaborate and cumbersome pre-heating equipment has generally been necessary for all Canadian, Alaskan, and other sub-Arctic operations.

Recently, a newly developed cold-starting fuel for aircraft operating in sub-zero temperatures was announced by The Texas Company, which is said to slice the time required for preparation and starting from as long as six hours to two minutes. This fuel is designed to replace high-octane gasolines for only the brief interval required to start. The fuel is used in regular aviation carburetor and priming systems. A portable external tank or bottle is attached to the aircraft's fuel lines which are shut off from the main fuel tanks, and the special fuel is allowed to flow for about two minutes. After engine is warmed up, the portable external tank may be disconnected by ground crew, the engine then draws its fuel from the aircraft's gasoline tanks.



Test pistons, 36-hour run (left to right) Permalube, quality oil, regular oil

The cold starting fuel is liquid at all atmospheric temperatures and can be shipped in regular containers, making special high-pressure containers unnecessary. Although development of these cold starting fuels is important from a military standpoint, it also suggests itself as an invaluable peace-time aid for transpolar and bush flying, and feeder lines operating in extremely cold climates.

External tank connected for starting

PHTHALIC ANHYDRIDE

Paint and Varnish Ingredient, Now Made from Petroleum

One of the most important chemical materials used in the manufacture of modern, high-quality paints and varnishes can now be made from petroleum sources instead of from coal, it was stated at a recent meeting of the American Institute of Chemical Engineers.

This development promises to free a vital industrial chemical known as phthalic anhydride from utter dependence upon coal mining and coke oven operations. Making this chemical is the Oronite Chemical Company plant, described as the first of its kind in the world to use a petroleum raw material for this basic paint substance.

The plant uses a raw chemical known as orthoxylene. Vapors of this substance are mixed with heated air and passed through the "converters" at a high temperature. The crude product formed is purified by crystallization and other means, and is then ready for use in the special paints and varnishes for refrigerators, automobiles, ranges, and so on.

SOAPS THAT

• LOOKING AHEAD •

New industrial uses for flammable gels. Paint that doesn't form pigment layers in storage containers. Further improvement in heavy-duty, metallic soap greases. Solutions to "impossible" problems

By D. H. KILLEFFER
Chemical Engineer

METALLIC soaps are a family of true soaps which above all are not soapy and hence are better entitled to be called "soapless soaps" than the modern soapy synthetics. Best known and most useless, of this extremely useful soap family is the ring in the family bath tub. But the annoying ring is a blacksheep and contrasts sharply with other highly useful members of the group that perform the most diverse, even contradictory, tasks. "Paradox" is the middle name of the metallic soaps. Among them, for example, a water-soluble waterproofing agent, friction producing materials and lubricants, adhesives and parting agents that promote separation, flammable flame-retarding compounds, emulsifiers and demulsifiers, polishes and flatting agents, gel-formers and gel-breakers—truly a package of paradoxes, but every one useful.

When a solution of a salt of an appropriate metal is mixed with a solution of a soluble soap, the metallic soap curds out. The basic process of manufacture is essentially that, although not quite so simple. Most applications of the metallic soaps depend more on physical than on chemical properties and therefore even minor modifications in the conditions of manufacture can cause differences in product quite out of proportion to their apparent importance. Small variations in concentrations of the solutions, their temperature, the vigor of mixing and stirring, the degree of acidity or alkalinity of the mixture during precipitation—all of these and other conditions control the properties of the product and thus establish its specific usefulness.

Most important members of this valuable family are the stearates of aluminum, ammonium, calcium, magnesium, and zinc. These are the tonnage products in the group which includes numerous others also highly useful but in lesser quantities.

Many of the commercial members of the family are compounds of the metals with mixtures of stearic acid, the fatty acid predominant in animal fats, and palmitic acid, similarly predominant in vegetable oils. Often the mixed fatty acids produce metallic soaps better adapted to specific purposes than those made with the pure acids.

Courtesy Standard Oil Company (N. J.)

Cakes of newly made grease, lubricant world is a major user of metallic soaps

MAKE OILS "STAY PUT"—"Soaps without soapiness," are basically old and the beginnings of their importance extends back to the early years of the industrial revolution when an expanding variety of machines of growing complexity needed something better and more specific than animal fats and whale oil to lubricate them. Thus came about the earliest use of a metallic soap—calcium stearate—to convert fluid oils into semi-solid grease that would remain in bearings.

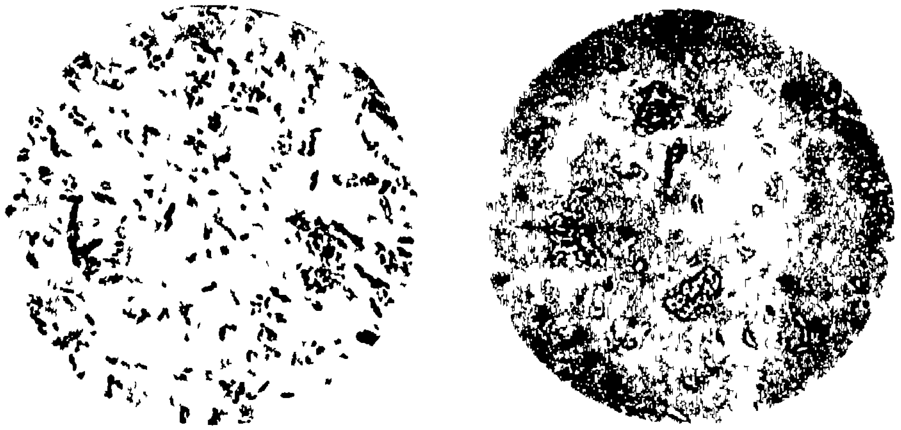
Next came the use of zinc stearate in cosmetic powders alone or mixed with rice flour or talcum powder. A strange contrast typical of metal-soap uses, between industry's heavy bearings and a baby's tender skin. Today, these comparatively simple early developments have grown into a valuable industry supplying the keys to unlock many puzzling industrial problems.

Nowhere is the paradoxical nature of metallic soaps so apparent as in their behavior toward friction. The bases of most frictioning compounds applied to power belts to prevent them from slipping on their pulleys are metallic soaps, and other members of the same family provide non-skid surfaces between rugs and highly polished waxed floors. Yet, under quite different conditions, soaps such as zinc stearate behave as effective lubricants between metal surfaces that are too hot for an ordinary oil or grease to stay on. Moreover, the ability of metallic soaps to form gels with fluid oils is fundamental to lubricating most bearings in equipment ranging from ancient ox carts to journal bearings in high speed machine tools.

The function of the metallic soap is to hold the oil in place so that it can properly lubricate the surfaces. Grease so made is able by its basic structure to maintain itself, to stand up, sometimes under considerable

WASH NOTHING

Lubricating Bearings, Powdering a Baby, and Waterproofing a Brick Wall are All In a Day's Work for the Metallic Soap Family. Other Surprising and Paradoxical Abilities of These Old-Yet-New Materials Are Constantly Appearing as Answers to Baffling Industrial Problems



Courtesy Mallinckrodt Chemical Works

Minor variations in making metallic soaps cause distinct differences in their properties. Zinc stearate, viewed at 300X shows fine, uniform particles (left) and each gram has 19,000 square centimeters of film area. Other sample (right) is non uniform, has 7500 square centimeters of film area per gram. To users, such factors may be vital.

heating and this property it owes to the potential ability of the metallic soaps to form gels with even thin oils. Apparently metallic soaps bear somewhat the same relation to oils and even gasoline that gelatin and pectin do to water. All form more or less solid gels.

GELS THAT STICK—The oldest application of metallic soaps—the production of grease gels—achieved extraordinary importance during the recent war in tremendously enhancing the effectiveness of fire bombs and flame throwers. This use stemmed from the fact that flames of gasoline or oil thrown by a flame thrower or bomb may not ignite the target because the burning gas which is the flame, cannot adhere to it. An answer was sought in a gelled fuel that would adhere to the target, whatever it might be, and continue burning with a flame hot enough to be effective. Early attempts were based on gels of gasoline with raw rubber. This mixture although it forms effective gels, was not practical because no rubber could be spared for this purpose.

Then metallic soaps came into the picture. The development of a gasoline gelled in this way was by no means simple, for the very diversities of character that make metallic soaps so interesting also create a virtual labyrinth of possibilities that must be explored to find the answer to any specific problem.

With the clue that even thin lubricating oils can be gelled by calcium stearate and others, and that such gels cling to bearings, researchers set out to discover what soap or combination of soaps would convert gasoline into a gel of just the right consistency and of strong adhesiveness to cling to combustible targets and set them afire. Even the initial consistency of the fuel was possibly less important than the ability of the flaming product to retain its clinging characteristic until the target was well ignited.

The final solution was found in aluminum soaps made from a mixture of the fatty acids of coconut oil with napthenic acids from petroleum. It was called Napalm. While the original objective was to use this product in fire bombs to be dropped from the air, its most remarkable success was realized in the flame throwers. Clearly the need for such a material as a military weapon is now very small, but the possibilities of peace-time use of a similar technique are likely to be important.

FLAMEPROOFING—This control of fuels by metallic soaps contrasts sharply with the effectiveness of the same agents in suppressing flammability. The fire hazard from many types of textile fabrics for example, lies in the easy ignition of surface lint and the low ignition temperature of the fibers themselves. Extremely small amounts of metallic soaps spread in an even but very thin layer on the cloth fibers effectively changes the nature of the surface of hangings and draperies. Such a procedure affords considerable protection against flash fires.

The metallic soap tends to hold stray fibers against the threads, thus reducing their flash potential, and at the same time the extremely thin layer of the compound substitutes its relatively high ignition temperature for the lower one of the fiber itself. Although this is not complete fireproofing by any means, it at least suppresses the extreme hazard of flash firing which constitutes a dominant hazard in public places. The metallic soap itself will ultimately burn but it is quite difficult to ignite—an important factor in fire hazards.

PARTING COMPOUNDS — The principal effectiveness of the Napalm fuel is the adhesiveness imparted to the gasoline by the addition of metallic soaps. But this adhesive quality is a quality of this particular type of gel, and is not

Checking consistency of fresh grease

"Gel-gas" has surprising stickiness and probably has more than one use

necessarily inherent in the metallic soaps themselves

Actually, an important field of usefulness of these "non-soapy" soaps is in parting preparations employed to assist in separating molded plastics articles from the molds in which they are formed Minimum amounts of aluminum or zinc stearate added to the molding compound or dusted separately into the mold cavity ahead of the charge allows the finished product to be ejected much more easily at the proper point in the cycle In addition, the compound assists the flow of the plastics into the fine features of the mold, thus improving the finish of the final molded piece

A similar application of magnesium stearate or calcium stearate assists pharmaceutical manufacturers in pressing tablets of certain remedial agents which are otherwise difficult or even impossible to mold on modern machines Typical are lozenges stamped from mixtures containing large proportions of sugar or dextrose, and tablets of ferrous sulfate

GREAT VERSATILITY — Metallic soaps are useful constituents of the wax mixtures used for polishing purposes, since their gelling action suppresses the tendency of some waxes, notably paraffins, to crystallize. On the opposite end of this scale, addition of metallic stearates to oil varnishes suppresses the gloss of the dried coating and without exertion gives the finished work a dull surface resembling that attained by rubbing.

The suppression of crystallization of paraffin waxes effected by metallic soaps is also important in the preparation of wax coatings to be applied to paper and similar flexible materials The layer of a compounded wax possesses far greater flexibility and a much reduced tendency to crack or to separate from the base materials on flexing

The gelling quality of metallic soaps can also be effective in holding heavy pigments in suspension in paint vehicles when they would ordinarily separate out as heavy layers in the can or barrel. This effect of additions of 1 or 2 percent of the appropriate metallic soap to a paint vehicle is particularly useful where differences in settling rates of several mixed pigments may change the color of the paint as it stands, a change not always easy to reverse with the ineffective stirrers available in the field Mixtures of heavy lead pigments with organic lakes as tinting agents are particularly troublesome in this way

Additions of metallic soaps to suspensions of pigments in vehicles also assist in emulsifying the resin-oil-pigment mixture in water as practiced in the newer types of water emulsion paints This action is the antithesis of that expected of metallic soaps in breaking and preventing emulsification

Ammonium stearate, unlike the other metallic soaps, is soluble in water, but it is also a valuable waterproofing agent The advantage of this technique lies in the ease of application of the ammonium stearate in water solution to brick or plasterwork, for example, as compared with the necessity of employing a much more expensive organic solvent to spread stearic acid alone Furthermore, the difference in spreading power of the organic solution and the water solution are important in achieving the final result. Other metallic soaps, particularly zinc stearate, also repel water and thus serve in many applications where a surface is to be protected from wetting

Clearly, the metallic soaps are shown by even these few examples to be remarkable, versatile, and useful materials In their peculiarly paradoxical properties are to be found solutions for many pressing problems of industry At least they are worth careful investigation when problems arise that seem impossible to solve

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SHIP FOULING

May be Reduced by
Changing Electrical Charge

Research conducted in Germany, and abandoned because of the war, included a project that suggests a new attack on the age-old problem of fouling of ships' bottoms The new basic theory is that the seeds and larval forms of the organisms involved in fouling are attracted to the ship's bottom by an opposite electrical charge Furthermore, this theory is supported by the failure of fouling organisms to attach themselves to certain natural inhabitants of the sea—seaweed, and jellyfish, for example—that carry like charges

Preliminary tests with certain insoluble alginate salts showed them capable of imparting a charge to objects in the sea coated with them and to repel fouling organisms in their rudimentary stages Investigation along this line is expected to be resumed or undertaken by others and may well lead to entirely new types of non-toxic anti-fouling compositions to protect shipping in the future

CESIUM-VAPOR LAMPS

Throw Little Visible
Light, Strong Infra-Red

Highly valued, not for their efficiency as illuminators but rather because their light cannot be seen easily, cesium-vapor lamps are similar in principle to the efficient sodium-vapor lamps employed in lighting highways They emit radiation strong in infra-red, which is invisible, but weak in visible light

Consequently these lamps have found important applications in secret communication, particularly when the freedom of this type of communication from interference by static or jamming is vital The lamps are filled with a mixture of argon and cesium vapor

MOVABLE ALCOHOL PLANT

Converts Crops at Farm
Site by Continuous Process

Built in a series of mobile units to be taken to farms for processing surplus and sub-standard crops on the spot, a new alcohol plant, when complete, occupies a five-car railroad train It is designed around the latest continuous processes of fermentation and distillation so that the highest efficiency of conversion and largest output can be obtained with a minimum of equipment.

The processes have been lately developed and have been demonstrated on a pilot-plant scale as well as in stationary plants. The system was demonstrated at a recent National Chemical Exposition and it is expected that a full-size demonstration unit will be built by next season

PIPE with a future

Asbestos-Cement Pipe, In Addition to Being Highly Resistant to Under-Ground Corrosion, Is Free of Tuberculation and Excessive Ground-Water Infiltration Added Up, These Features Mean Long Useful Life

By JEROME CAMPBELL

When the city-fathers of a given municipality decide to spend some of the taxpayers' money for a new sewage-disposal or water-supply system, and when the engineers entrusted with designing get down to brass-tack estimating, one of the first questions that arises is "What kind of pipe will be the most efficient for this job—both now and in the years to come?"

The "years to come" part of that question is often the most vital part Water pipe that serves adequately for a short time and then because of internal corrosion starts to require more and more pumping pressure, and eventually heavier pumping equipment, is not economical Neither are sewer lines that infiltrate thousands of gallons of ground water which must pass through the treatment plant along with the sewage

As a result of these factors, and a multitude of others, the log of piping materials that have been tried with varying degrees of success is a long one But one type of piping, made from asbestos and cement, has been standing at or near the top of the list for many years Despite its existing record, asbestos-cement pipe is not widely known and is even now just being "discovered" by persons involved in today's extensive building programs—industrial and domestic

The ability of asbestos-cement pipe to meet the demands of long-range planning for water and sewer systems, its freedom from various types of corrosion, and its internal smoothness that keeps flow capacity at a peak through the years, are responsible for this material's excellent record in underground service. Sewers and water mains, however, are not the only fields where long, grey tubes of asbestos and cement are doing a good job It is also nicely suited for flue-pipe, vent stacks and ducts, and electrical conduits

BUILT-UP PIPE—The material of which the pipe is made could be called a compounded mineral Two mineral substances, asbestos and cement, are blended and integrated to make a smooth, hard, close-textured piping, stone-like in durability, but not brittle or easily broken This pipe can be cut with ordinary saws to accurate dimensions and machined to close tolerances

In manufacturing it, asbestos fibers are first selected and blended to obtain maximum durability and toughness Then in pre-determined proportions, the fibers are mixed with cement and a sufficient volume of water is added to disperse the fibers uniformly through the mixture

This mixture or slurry, as it is called, flows into a tank where a revolving drum of fine wire mesh deposits it in a coating about 1/100 of an inch thick, on a broad, endless felt band The moving felt carries the thin coating in a wide ribbon over vacuum chambers, which remove excess moisture from the mixture and then transfers it to a revolving polished steel mandrel Here the coating builds up continuously under the pressure of heavy hydraulically loaded rolls which compress it into a dense, homogeneous structure

In this way, a pipe the length of the mandrel is built up until the desired wall thickness is reached After the pipe is removed from the mandrel and put through an extensive curing process, the asbestos-cement walls are found to be smooth and hard, with great toughness and durability, yet surprisingly light in weight. Modern equipment forms asbestos-cement pipe in 13-foot lengths, in diameters ranging from three to 36 inches, and in four pressure or strength classes Which of these sizes and strengths is selected by the user depends, of course, on the application. Lighter weights, for example, are more generally used for flues and stacks than for underground installations where overhead loads are a factor

Asbestos cement pipe in 13-foot lengths is joined together by sleeve couplings made of the same material. Hydraulically operated puller is used to draw the coupling over the ends

• LOOKING AHEAD •

Wider knowledge and greater appreciation of asbestos-cement pipe. Extensive use in "hurry-up" building projects where ease of installation is vital Savings in terms of critical metal supplies Better municipal sanitation at lower cost

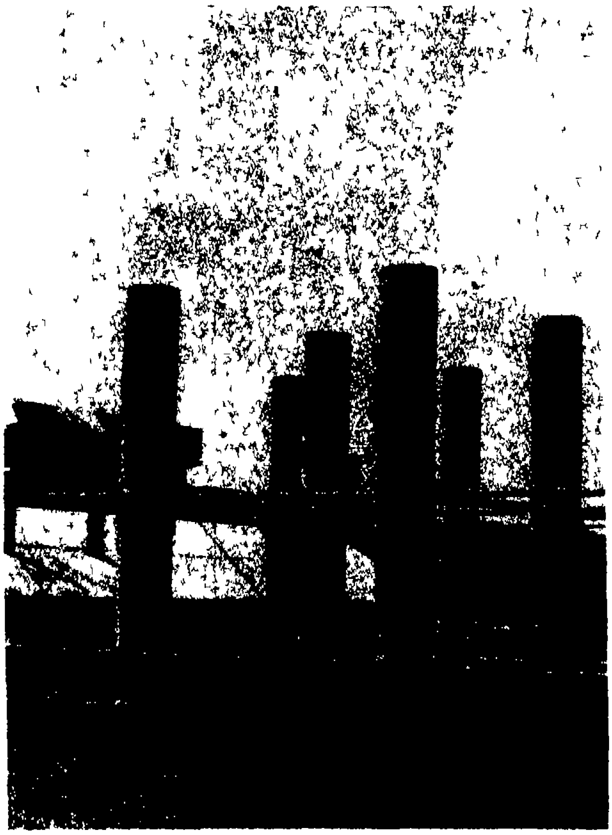
LONG LIFE—Most water and sewer pipe lines are generally buried in the soil. Here, broadly speaking, two types of corrosion can take place—chemical and electro-chemical Chemical corrosion is caused by the acids and salts encountered in the soil Although these active agents would be able to leach out the free lime in neat cement, asbestos-cement pipe is so cured as to convert the free lime in its composition to insoluble silicates This insolubility gives the pipe a high resistance to the leaching tendencies of the soil. Electro-chemical corrosion, on the other hand, is an extremely complex process when it occurs in metallic pipe installed underground and is analogous to the action which takes place in a dry cell In brief, certain areas of the pipe surface which are shielded from oxygen begin to function as anodes and become corroded Other areas behave as cathodes and do not corrode Asbestos-cement pipe, being non-metalic, does not conduct electricity Hence it is entirely free from electro-chemical corrosion

An equally important advantage of asbestos-cement pipe is its high flow capacity, stemming from the smooth interior surface imparted to the pipe by the polished steel mandrel on which it is built up Water flows easily along this smooth surface, permitting high carrying capacities and low pumping costs

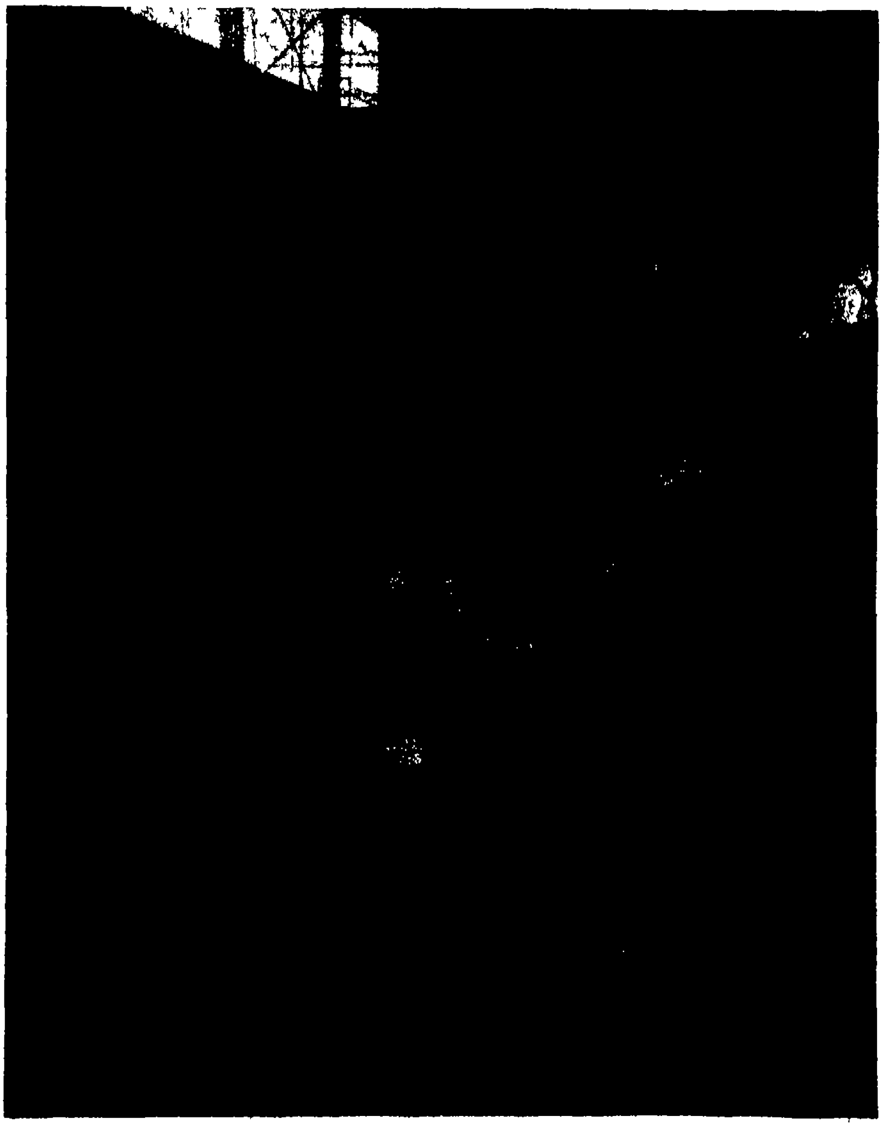
Tying in with these two factors of flow capacity and pumping costs, is the freedom of asbestos-cement pipe from tuberculation This is the technical term for an evil that often effects serious reductions in the carrying capacity of cast iron and steel pipe The word is derived from the "tubercles" or stalactite-like nodules that multiply on the interior surface of ferrous pipe There they cling tenaciously, increasing the resistance of the pipe to the water flowing through it The increased friction and turbulence of flow diminishes the efficiency of the pipe and in some cases gradually reduces the effective interior diameter until there remains only a small fraction of the pipe's original water-carrying capacity

Because these tubercles do not "grow" on the interior surface of asbestos-cement pipe, its carrying capacity, over years of service, remains undiminished Clearly, this advantage is important to the engineer designing a water system Pipe sizes and pump pressures can be determined on the basis of present and estimated future water requirements of the community There is no need to specify larger pipe and higher pumping pressures so as to make provision for future deterioration in the line's carrying capacity as a result of tuberculation Also, because smaller pipe can be used, it is often possible to provide for more extensive pipe installations without increasing costs

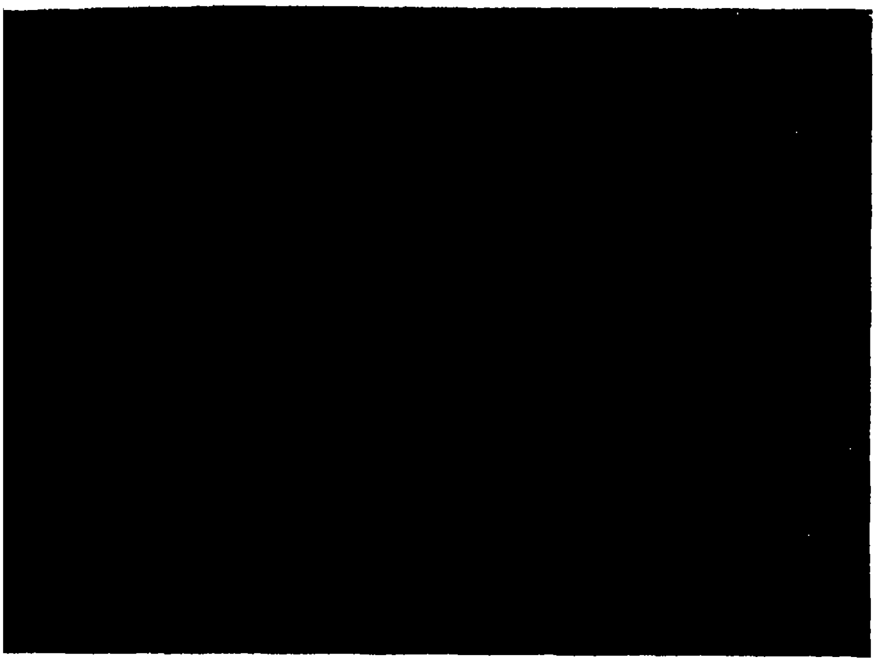
Corrosion-resistant asbestos-cement pipe is used for ventilating duct on the roof (right) of a large chemical plant



Workmen (below) are shown operating the carriage which slides a finished length of pipe from the mandrel, while on the machine in the background pipe is being rolled on an alternate mandrel



FLEXIBLE INSTALLATION—When used in water lines, asbestos-cement pipe is joined by a sleeve coupling, of the same material as the pipe, fitted over the abutting ends of the two lengths to be coupled Two rubber rings seal the space between pipe and sleeve Quickly assembled without the use of molten lead caulking or similar hot compounds, the sleeve coupling makes a leakproof and flexible joint For sewer pipes a somewhat different coup-



coal mine installations, asbestos cement pipe has demonstrated its ability to resist for relatively long periods the corrosive actions of highly acid mine waters which sometimes eat away metallic pipe in a matter of days

ling is used, but coming in 13-foot lengths, this pipe has fewer joints than other kinds of sewer pipe which are made generally in three and four foot lengths.

The flexibility of the coupling plus the high crushing strength of asbestos-cement pipe, enables water lines made of it to resist the weaving and shifting of the soil, as well as the weight of passing traffic.

LOW INFILTRATION — Fewer joints, in addition to simplifying installation, mean less infiltration of ground water into the asbestos-cement pipe, since nearly all seepage of ground water into sewer lines occurs at the couplings. Reduced infiltration, in turn, makes for more economical and efficient operation of treatment plants. Ground water infiltrating into sewer lines is considered by treatment-plant operators and sanitary engineers to be one of the major problems of sewage treatment.

Generally speaking, when a new sewer is installed and tested, the allowable amount of infiltration is fixed at not more than one gallon per hour per inch of pipe diameter per 100 feet of line. For eight-inch pipe this amounts to an allowable infiltration of approximately 10,000 gallons per mile per day. Infiltrating ground water costs virtually as much to process at a treatment plant as raw sewage. Hence, the low infiltration rate prevailing in sewer lines of asbestos-cement pipe brings down treatment plant operating costs and sometimes permits the erection of smaller plants at correspondingly smaller expenditures.

Aside from the foregoing uses, asbestos-cement flue pipe is finding application for venting gas-burning appliances. Durability, pleasing appearance, and a relatively low heat conductivity that retards the rate of drop in flue-gas temperature, all contribute to its suitability for this field. Draft conditions are improved and condensation reduced because of the heat-conductivity factor.

Similarly, the light weight and corrosion resistance of asbestos-cement pipe make it convenient for venting industrial fumes and gas when it is installed as ducts, vents, and stacks. Metal heating and melting operations, grinding and polishing of glass, stone, or metal, and chemical processing that gives rise to corrosive fumes or gases, are cited as a few of the applications where asbestos-cement vent piping has made good. Because of its strength and corrosion-resistant qualities, this type of ventilating pipe may be used on the outside of industrial buildings without painting.

The new homes, new roads, and new factories now building or planned will increase the demand for a durable, quickly assembled and long-lasting pipe to bring supplies of pure water, to carry away sewage, and for drainage and ventilating purposes. In helping to fill this demand asbestos-cement pipe promises to make a growing contribution to the country's domestic and industrial well-being.

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CONTINUOUS RAIL

Increases Life of Rolling Stock, Wider Use Expected

Now 16 years old, welded, or "continuous" railroad rail is a youngster in the railroad family, but some authorities expect this method of track construction to be used more widely in the future. At present, continuous rails account for a negligible percentage of all the track laid in the United States. Reliable estimates place the total in the neighborhood of 100 miles. About 33 miles of this is in special installations over bridges and grade crossings, through tunnels and stations, and in city streets. The remainder is open track.

According to railroad experts, long sections of welded rail have certain advantages over the standard track made of 39-foot sections. These advantages include reduced shock on rails, rolling stock, and freight, reduced noise for passengers, lessening of impact of bridge loads, as much as 50 percent in some cases, and where long sections are used at crossings and in city streets, damage to pavement near the track is reduced.

The first continuous rail was laid through a tunnel by the Central of Georgia in 1930. Today at least 17 roads have installed varying amounts of welded track up to a total of 42 miles on one road. The lengths range from a few hundred feet up to 7000 feet, the longest single piece now in use in open track.

On the rail itself, a temperature variation from one season to another of 100 degrees, Fahrenheit, is commonplace in many sections of the country. Unrestrained, a single section of steel rail one mile long would lengthen about 41 inches during a temperature rise of 100 degrees. The largest single holding force is the friction that exists between the rail and the tie plate that holds the rail upon the tie. The ballast in the road holds the tie and rail. Extra clamps are placed at each end of the continuous section to control any movement.

Best results are obtained by laying the rail at a time when the temperature lies midway between the expected high and low for that section of the country. This cuts the possible expansion or contraction about in half. Railroad engineers say that by using these methods no more expansion is noticed than can be taken care of by the bolt clearances in the plates that connect the separate sections This is no more than is normal in the standard rail

Proponents of continuous rail believe that this method of construction holds a promise of higher speeds, greater comfort for passengers, and increasingly long life for railroad equipment

COAL MINE HAZARDS

Reduced Greatly by Use of New Devices, Explosives

MORE than 100 different safety devices, machines, and methods have been introduced into United States coal mines in the past 20 years Costing more than $100,000,000, the safety measures are credited by the Bituminous Coal Institute with reducing accidents by nearly one half during this period, or at the rate of about 4 percent per year on a basis of production

Since World War I, a widespread change from the use of black powder and dynamite to the use of permissible modified explosives producing reduced flames and reduced temperatures is said to have diminished one of the major hazards of mining by more than 50 percent Coal miners are the largest peace-time users of explosives and 180 different brands conforming to safety standards approved by the United States Bureau of Mines or an accepted testing agency are said to be used now

Though many miners themselves are reported to have objected to the original change from oil or carbide to electric safety lamps made mandatory by the coal operators, and to the compulsory introduction of hard hats, hard-toed shoes, safety belts, and safety appurtenances, the general use of these devices is said to have precluded many thousands of accidents. Over 20 automatic signals, alarms, and gages are stated to be in use now to record water pressures mechanically, detect the presence of gases, break electrical circuits, and otherwise afford instant protection from operating hazards

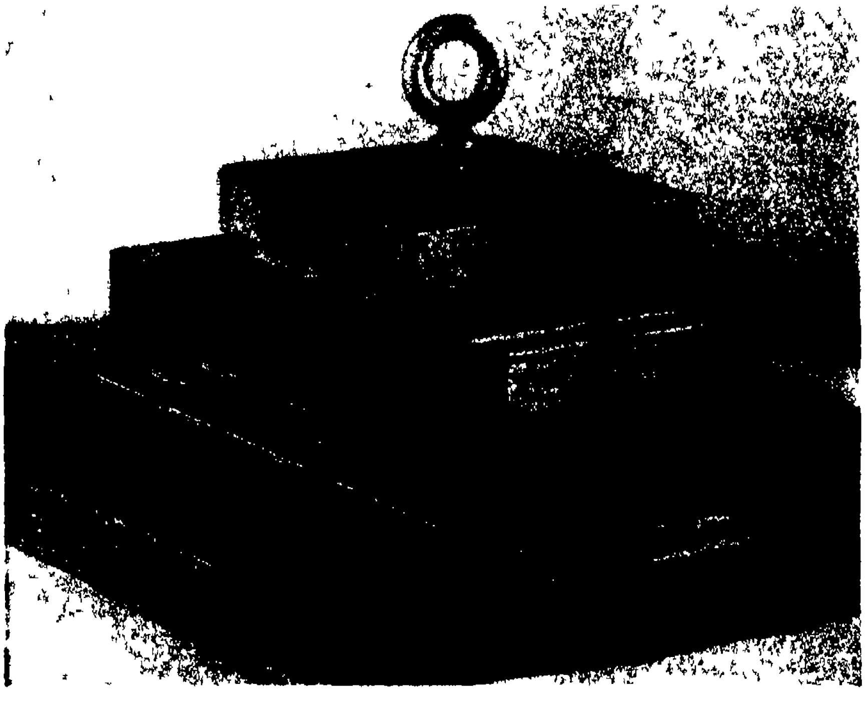
The prevention or spread of underground fires has been decreased sharply by the extensive use of calcium chloride in allaying accumulations of coal dust, by fire-proofing ventilation guides, housings for electrical equipment, shaft lines, mine entrances, overcasts, and the erection of fire-proof doors in the mines

The first safety director for a coal mine is said to have been appointed in 1910 but now one or more such specialists in accident prevention are on the staff of every major coal mining company in the nation

ROLLER-BEARING FOUNDATION

Permits Six-Inch Building Shift During Earthquakes

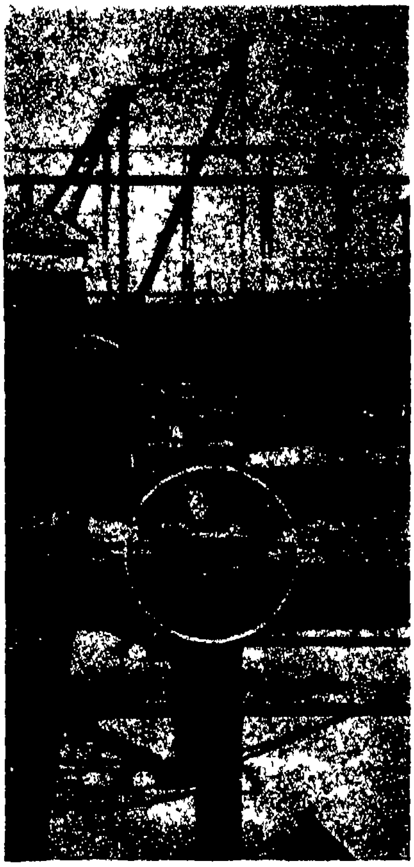
ENABLING a building to "roll with the punch" of an earth tremor, anti-earthquake roller bearings are being installed under a new west-coast building Weighing 600 pounds each, 65 sets of these specially designed bearings are being used to protect from earth shocks a three-story addition atop an existing six-story building Placed under the main pillars of the addition, each bearing assembly supports a load of 250,000 pounds and, acting together, they permit the addition to move six inches in any direction.



Sealed and lubricated for life, 600-pound bearings can move any direction

This unique roller-bearing construction was necessary because the six-story structure upon which the new addition rests was built before a now existing building code was adopted This code demands construction which takes into account earthquake stresses It was found that any attempt to strengthen the present building would result in excessive costs, and also prohibitive disruption of company activities

By "floating" the three-story addition on roller bearings, the vertical loads, due to gravity, are divorced from the horizontal forces exerted by the ground waves of an earthquake Each anti-earthquake bearing consists of three steel plates with two interposed sets of steel rollers placed at right angles to each other The rollers between the bottom and center plate roll in a north-south direction, while those above move east and west If a diagonal shock is encountered, both sets of rollers operate



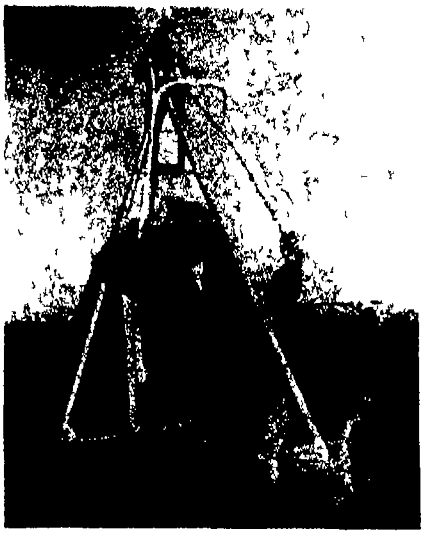
Each group of rollers is hermetically sealed so no foreign matter can penetrate, and lubricated with a special type of oil. Because of the tremendous weight they carry, the rollers, and the steel plates upon which they move, are made of tough

steel, ground and polished to mirror-like smoothness and precise measurements according to their manufacturer, the Torrington Company

AUTOGYRO GLIDER

May be Towed by Plane, Holds Commercial Possibilities

A most unusual development in the glider field, an odd-looking wingless craft which works like an autogyro without a power source, has recently been developed at the General Electric Flight Test Center.

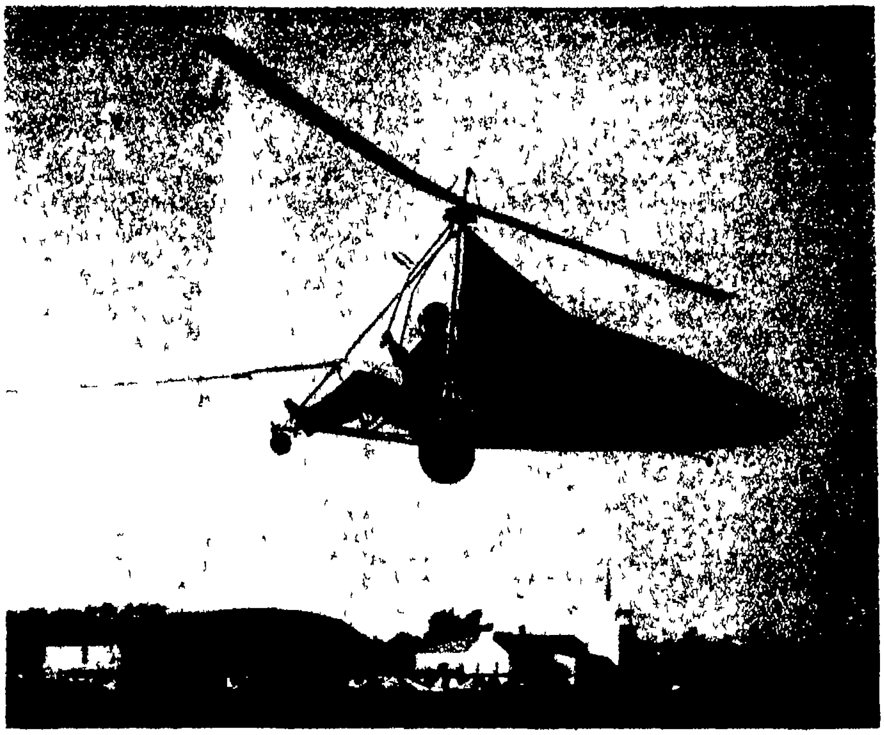


Known as the Gyro-Glider, the craft is supported by two nine-foot rotating blades atop the fuselage. Weighing 120 pounds ready to fly, it is capable of lifting nearly 300 pounds—pilot and cargo—in addition to its own weight.

The Gyro-Glider can land in extremely small areas, requiring a landing field not more than 60 feet is diameter, according to the company's design engineers.

Expected to have wide commercial application as a means of reaching isolated areas without adequate landing fields, the Gyro-Glider is one third the weight of a standard fixed-wing glider and can be steered within limited range and land on any spot of the pilot's choice. For such use, the glider would be towed by an airplane and released like a standard glider. It has a descending speed less than than that of a parachute and can be landed with such ease that it is not likely that damage would be caused to the cargo.

Like an autogyro, the new glider makes a forward roll of 20 to 30 feet when landing. The rotating blades, can be easily removed so that the craft can be transported from home to airport in the rear of a station wagon, which also can serve as its towing agent. The new craft is equipped with a tricycle landing gear.



Simplified controls, high lift—300 pounds plus own weight—spell promise for this craft. With pilot replaced by cargo, and radio control, glider could make deliveries in tight fields

According to Mr. David C. Prince, one of the designers, an independent means of bringing the rotor up to speed would eliminate the tow run at take-off.

UNSTABLE GLASS

Has High Light Transmission Speed

Light travels faster through beryllium-fluoride glass than through any other glass, solid, or liquid, the American Optical Company reported recently in announcing that the optical properties of the new glass have been successfully measured for the first time.

The report said that light travels through space at the rate of 186,000 miles per second, and through the beryllium-fluoride glass at 146,000 miles per second. In comparison, light travels through water at 140,000 miles and through spectacle glass at 122,000 miles per second.

The measurements also showed that the beryllium-fluoride glass separates light into its component colors far less than any previously known substance. Accordingly, if it could be used in making a lens it would produce less color aberration.

The glass-forming properties of beryllium fluoride a material used in making beryllium metal, which in turn is employed to harden copper and other metals were first predicted and demonstrated in 1927 by V. M. Goldschmidt, a German scientist. He predicted that the glass would have a low refractive index (light-bending power) and a low color dispersion, but apparently never measured these optical properties.

Special steps had to be taken to measure the glass because it is extremely hygroscopic. When exposed to air, it absorbs moisture so rapidly that a prism made of it collapses into a puddle. As a result, such prisms could only be polished by means of techniques specially developed for the investigation.

In composition, the beryllium fluoride differs from ordinary sand glass in that fluorine, a poisonous gas related to chlorine, replaces oxygen and beryllium replaces silicon. The samples measured were made by the Brush Beryllium Company.

RESISTANCE WELDING

Accomplished by Battery Power, Carbon-Pile Control

In many industrial localities, the power facilities available have not permitted use of fast and low cost resistance welding for the fabrication of metal products. In addition, resistance welding has grown so rapidly in recent years that power supply difficulties have been experienced even in major industrial areas. At a recent meeting of the American Society of Mechanical Engineers, Mr. John D. Gordon of the Progressive Welder Corporation pointed out one solution to this problem involving the use of carbon's characteristic ability to conduct electricity better when under pressure than when no pressure is applied

Here, the question was the storage of electrical energy in some manner in the time interval between welds, the most obvious method of storing energy being the storage battery However, no one until recently had found any way of interrupting the enormous low-voltage currents when using batteries The answer was finally evolved, according to Mr Gordon, in the "carbon pile rheostat"—a very common device but not previously considered in this connection The device makes it possible to interrupt current flow simply by releasing the pressure used to press two discs of carbon together

Storage battery welders, it was added are no longer experimental today They are being used to weld almost everything from thin sections of ordinary steel or stainless steel, to heavy sections of aluminum When welding those materials which require exceptionally heavy currents it is only necessary to add more battery cells

The storage batteries are kept charged between welding operations by battery chargers similar to those used to charge automobile batteries

CARBIDE PLANER TOOLS

Allow Higher Output,
Take Interruptions Successfully

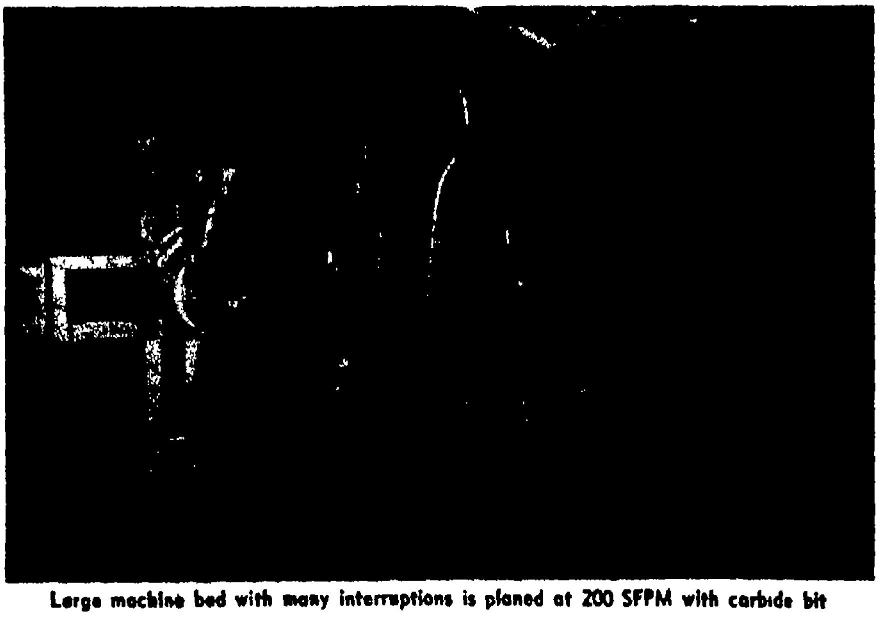
THAT the relatively slower speeds of most planers—measured in SFPM—make this type of machine tool less adaptable to carbides is a theory not supported by facts Routine planing with carbide tools of such ferrous castings as turret-lathe pedestals, turret slides and saddles, cross slides, and cross-slide carriages, for example, has been successfully accomplished by one manufacturer over a five-year period

The company states that with good tool practice and good operators, carbides are preferred for most planing operations since not only greater output—on the newer planing machines capable of 200 SFPM—but also better size and finish is obtained than with high-speed steel tools The steel tools are still used, however, on exceptionally deep hogging cuts—over ⅝ inch depth of cut—and those cuts, usually in slotting, in which depth of cut would exceed the lift of the clapper box

The users, Warner and Swasey Company, report that their experience appears to indicate that Carboloy tools can take severe interruptions in cutting In planing the large bed for a textile machine, for example, many interruptions are caused by the necessity of internally bracing the machine base to provide the rigidity required in the finished machine Here, planer speeds of about 200 SFPM are used

Further, experience to date indicates that available planer speeds—usually on the "low" side when general carbide machining practice is considered—present no difficulties Good results are being obtained with Carboloy tools even on older machines with top practical speeds of as low as 70 feet per minute or less When used on these older machines, carbides have the advantage of longer service life between grinds On the newer machines, 200 SFPM is standard shop practice, and usually from 4 to 24 pieces are planed in a single set-up

In setting up for planing any kind of iron casting at the user's plant reference is made in the shop to simple tooling data sheets which cover the general classes of planing These sheets provide needed data on number of cuts, types of tools, feed, depth of cut, speed of cutting, and speed of return In general, cutting recommendations are based on the slowest planer which might be used for this type of work

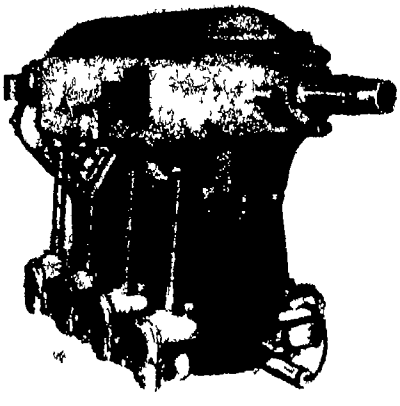


Large machine bed with many interruptions is planed at 200 SFPM with carbide bit

IN-LINE AERO ENGINE

Features Light Weight,
Internal Cylinder Cooling

DESIGNED for the personal-plane field, a new light-weight, four-cylinder, in-line, air-cooled engine develops 125 horsepower at 2500 revolutions per minute and 110 horsepower at 2200 revolutions per minute Designated the Cameron C4-I-E1, the engine is said to be particularly desirable for twin-engine installations, as well as for single-engine airplanes, due to its minimum frontal area Total dry weight of the production model will be under 200 pounds, or approximately 1½ pounds per horsepower



Valves serviced, cylinders remain on

In addition to extreme light weight and minimum frontal area, other features of the engine include positive fuel injection, internal cooling of cylinders through an unusual design feature, accessibility of valves and seats for servicing with cylinders remaining on the engine, and a deep-groove ball thrust bearing

Since the Cameron engine utilizes a full-pressure, dry-sump lubrication system, it may be mounted in inverted or upright position to obtain the desired relation between thrust line and engine center of gravity

MESABI CO-OP IRON

Will Try State-Private
Conversion of Ore Waste

IN A CO-OPERATIVE program which may set the pattern for future development of natural resources, a modern plant is being built on the Mesabi Iron Range of northern Minnesota for the conversion of iron carbonate slate to pure iron powder The slate, heretofore a waste product, overlies the iron-ore formation and is present in great abundance, is uniform in composition, and is easily accessible.

In a continuous chemical process, susceptible to close control, the iron is dissolved out of the ore by acid, precipitated as crystals of iron sulfate, and preferentially roasted to iron oxide of high purity. This product is then reduced to iron powder of controlled physical characteristics with a purity of over 99 percent.

Already proved in the laboratory as a means of producing iron powder thoroughly adaptable to powder-metallurgy fabrication, the process has not yet been operated on a scale large enough to determine production rates and operating costs. The benefiits resulting from the establishment of a year-around metallurgical industry in the Mesabi Range area, and the possibility of development of a new resource, are the state of Minnesota's incentives for the sharing of the risk of the new enterprise with a private industrial organization, Continental Machines, Inc.

RUBBER LABORATORY

Carries On Extensive Work in Synthetic Field

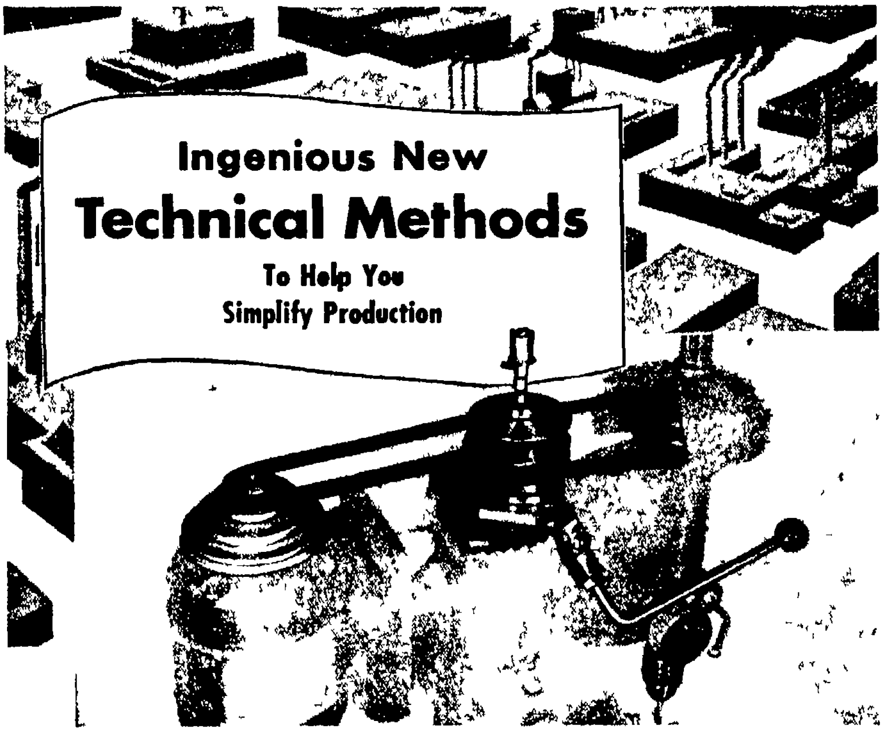
FIFTY new kinds of synthetic rubber have been made in a research laboratory, operated at the University of Illinois for the past three years in connection with the government's synthetic rubber program. In addition to developing the new rubbers, the laboratory's other projects have included: Establishment of the effect and importance of purity of materials going into synthetic rubber, study and improvement of the soap used in the rubber-making process, and devising analytical methods for controlling production and quality of rubber during its manufacture. The laboratory at the University is devoted entirely to research on improvements in rubber manufacturing and new types of rubber, and involves no work in compounding, vulcanizing, or tire building.

While all rubber now being used for tires is made through an emulsion process, the chemists also studied a Russian process using sodium in place of soap emulsion, and compared results of the two processes. From this they have learned how to make a better sodium-rubber which in preliminary tests revealed "marked superiority" in resistance to heat build-up and to cracking, the two greatest faults of present synthetic rubber.

Professor Carl S. Marvel, head of the laboratory, pointed out that today's synthetic-rubber passenger auto tires are practically equivalent in wear to pre-war tires made from natural rubber. They have been improved from 3000 miles of wear at 30 miles per hour to 55,000 miles at 50 miles per hour. Greater improvement is expected, and also improvement in heat resistance, which is the difficulty in using present synthetic rubber in heavy-duty tires. He believes that in not more than two more years, synthetic rubber will be well superior to the natural product, and the United States will be permanently free of dependence on foreign rubber sources.

Synthetic rubber is generally made in batches at the present time. The chemists at the University are studying chemicals which will enable rubber to be made by a continuous process. Many catalysts and activators are being examined, and success will increase rubber-plant capacity by making improved methods of production possible.

Another current problem is the study of dehydrogenated rosin soap as an ingredient in synthetic rubber. This has been shown to produce superior rubber, and its use relieves the need for more expensive soap, but it slows production. The problem is to avoid the slowdown, and progress on such lines is reported



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Now you can adjust drill press speeds from high to low—or any intermediate speed—as easily as shifting gears in your car! The Era Variable Speed Drive Attachment enables the operator to provide the correct speed for large or small drills by merely moving a lever. This saving in time results in greater work volume, better work, and lower production cost. **The Era** Attachment fits all popular makes of drill presses, and is easily installed without the necessity of drilling holes or changing present equipment.

To also help save time on the job, many plant owners make chewing gum available to workers. Chewing gum seems to make work go easier, time go faster. Wrigley's Spearmint Gum may be used even when both hands are busy, eliminating work interruptions, and thus promoting greater safety for the operator.

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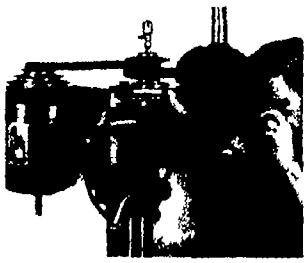
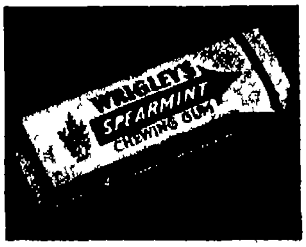


Era Variable Speed Drive



AA-203

New Products and Processes

RADIATION CALCULATOR

Eliminates Tedious Figuring In Planning Heating Systems

For measuring radiation for steam and hot water heating systems a new calculating device has been announced. It is claimed this new calculating device, called Heat-O-meter and physically a round dial with three concentric celluloid printed disks eliminates the tedious figuring usually necessary to determine the correct amount of radiation. Just the simple turning of a dial and the correct answer is received.

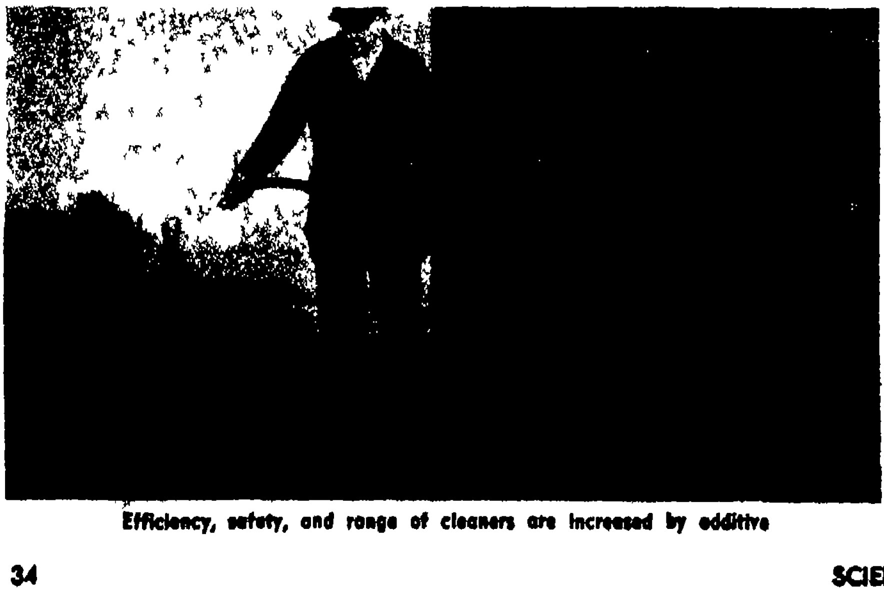
The dial contains sizes of mains, returns, risers, radiator sizes and capacities, round and sectional boiler net ratings, chimney flue sizes and capacities with minimum and maximum heights, hot water tank sizes and capacities fuel-oil tank sizes and capacities, hot water generator capacities and other valuable heating information enabling plumbers steamfitters, architects, builders oil-burner and heating salesmen, and all individuals who come in contact with heating problems to have the correct answers at their finger tips.

INDUSTRIAL CLEANERS

Gain Effectiveness, Safety, With Emulsifier Additive

Designed for use with kerosine and other petroleum cleaning agents to insure greater safety, efficiency, and economy a new emulsifying agent is intended for removing very heavy deposits of oil and light grease from all kinds of metal parts and equipment. In solution with petroleum cleaning agents the product called Mulsirex, adds to the cleaning potency of these agents through its deep penetrating qualities and, at the same time, because of its high flash point of 180 degrees, Fahrenheit, greatly increases the margin of safety for the operator. The emulsifying characteristics make foreign substances readily soluble in water, a feature that permits the deposits to be flushed away after application of the cleaning agent with a simple cold-water rinse.

Because Mulsirex can be used in dilutions as high as 1 to 10 with solvents, the manufacturer, Turco Products, Inc., points out that it is economical to use. Applied with a spray, brush, or mop, or as a cold-tank immersion solution, it is said to be harmless to metals and enameled surfaces.



Efficiency, safety, and range of cleaners are increased by additive

VACUUM GAGE

Combines Sensitivity, Ruggedness, and Portability

Designed for operations requiring continuous and accurate measurements of reduced pressures as low as 0.1 micron, a new vacuum measuring gage is said to be made virtually indestructible through the use of non-burn-out elements.

Originally a component of the RCA Electron Microscope, the gage has now been developed as a separate, easily portable unit, designed especially for modern vacuum systems in which rotary pumps are used to back oil diffusion pumps. Vacuum systems of this type are used in the dehydration of penicillin mold in the preparation of freeze-dry specimens, in metal sputtering and lens coating, and in vacuum distillation processes, both in the laboratory and in industry.

The new gage, for example, will continuously indicate the pressure while the mechanical pump is "rough" pumping, and serve to show the somewhat critical point at which the diffusion pump should be connected. The repetitive accuracy of the meter reduces the time usually lost in calculating error, and permits maximum time to be employed in actual operation.

The vacuum measuring unit, called type EMG, incorporates two types of gages, a thermocouple gage and a discharge gage. These gages have standard pipe fittings for connecting to a vacuum system and readings on the meters in the control unit are easily translated into accurate terms of pressure. All controls are on the front panel. Cables and connectors carrying the power supply for both gages also extend from the front panel. A rotary switch is used for operation of either gage.

For laboratory or production use

The thermocouple gage, used to make the higher pressure measurements, is housed in an all-metal enclosure to prevent any accidental mechanical damage. The discharge gage is the cold-cathode, diode type of ionization gage and is used to give current indications for very low pressure measurements. It contains no filament to burn out and is quite durable.

A special feature of the EMG vacuum gage makes it possible to use the same meter-control unit with any number and combination of gages. The gages can be permanently installed in the vacuum pumping units and the portable meter control unit can be plugged-in at any desired position to obtain a pressure reading.

The new instrument weighs only 18 pounds complete with gages and cables. It measures 10 inches high, 13½ inches wide, and 8¾ inches deep.

LUMINESCENT "LUCITE"

May be Fluorescent or Phosphorescent in Many Colors

Acrylic-resin sheeting containing luminescent pigments—a fluorescent type which glows when exposed to ultra-violet light, and a phosphorescent type which glows in the dark after exposure to ordinary light—promises wide use on highways, airlanes, and sea lanes. Phosphorescent acrylic, or "Lucite," is being investigated for large bands on channel markers and buoys to light them at night without necessitating maintenance or replenishment of a power supply. The plastics has demonstrated durability on exposure to severe weather or salt water.

The afterglow of the phosphorescent sheeting is claimed to be outstanding in the field of plastics. After exposure to light, the sheeting gives light of maximum brilliance for a matter of minutes, and then continues for ten or twelve hours to give light sufficient to be seen by an eye adapted to the dark The fluorescent sheeting, on the other hand, does not necessarily store light, but glows brilliantly while subjected to ultra-violet

Sheeting of both types is expected to be used in advertising signs Other potential uses include parts of lamps, baseboards, and panels for light switches used in bedrooms, directional signs of all types, house numbers, Christmas-tree ornaments, dial faces and airplane instrument panels, theater-exit signs, parts of radios and television sets, architectural panels, and entire walls and sections for bars

The sheets can be manufactured in a wide range of colors, in all of the standard sizes of regular "Lucite" sheeting, and in a variety of thicknesses

TANK BREATHER

Reduces Damage to Tank and Contents by Moist Air

Specially designed for industrial organizations employing storage tanks, a new line of improved breathers is now offered to help alleviate current difficulties in replacing corroded and outworn chemical and oil storage tanks, the latter conditions emphasizing the necessity of protecting the contents of such tanks against pollution and spoilage by atmospheric moisture

Air dried before entering tank

The breathers, in production at the Pittsburgh Lectrodryer Corporation, carry the name of Lectrobreathers and can either be mounted directly over a tank's vent or be piped to it Incoming air is thoroughly dried by its passage through activated aluminas contained in the breather, which is equipped with a color indicator for determining when the aluminas are in need of reactivation and when reactivation is complete

The manufacturer of this dehumidification equipment produces breathers in several standardized sizes, but advises that several factors be considered before any specific size or type is installed These factors include How frequently and how fast a tank is emptied, how many cubic feet the tank contains, the nature of the tank's contents, and weather conditions

PIRANI TUBES

Measure Gas Pressure By Filament Resistance

Suitable for pressure gages and leak detectors in evacuating apparatus and automatic pressure-recording equipment, electronic tubes designed with special tungsten filaments having a high temperature coefficient of resistance permitting direct readings of gas pressures are now available A change in gas pressure produces a change in thermal conductivity, filament temperature, and filament resistance Measurement of filament resistance, calibrated in terms of pressures for individual gases, is indicated on an 0-1 milliameter placed in a simple bridge circuit.

Matched pairs of these devices, called Pirani tubes, are recommended for greater accuracy according to the makers, Sylvania Electric Products, Inc. One tube is sealed directly into the evacuating system while the second or compensating tube is left open to surrounding air or filled with a specific gas to a standard pressure The tubes are usually mounted in close proximity

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6173 S*	34	65	1 00
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to provide the same ambient conditions and the installation is generally shielded from radiant heat or air currents

Readings may be obtained with plus or minus 5 percent accuracy within a pressure range of 1 to 1000 microns The tubes are supplied in nonex glass envelopes with tubulation for direct sealing into the apparatus The overall length of the tube is approximately eight inches They are designed to operate at 1 5 volts, 100 milliamperes Cold resistance of the filament is 6 6 ohms Hot resistance at 100 milliamperes in an evacuated tube ranges from 15 5 to 17 0 ohms

LIGHT-WEIGHT WIRE

Uses Aluminum Conductor, Glass Rubber Insulation

Reported to save 200 pounds of weight in the Consolidated Vultee B-36 bombing plane, a new electrical wire has an aluminum conductor and a fire-resistant insulation known as Neolay

The insulation consists of a layer of glass to insure circuit integrity and a fire-resistant synthetic rubber applied by a special dipping process developed by the United States Rubber Company

FORMABLE MAGNETS

Shaped from New Alloys for Difficult Jobs

Soft enough to be machined rather than ground two new magnet metals may be made into any size, shape, or form Called cunico and cunife, the new metals can be made in the shape of plates, in the form of screws, punched out in various square and circular shapes, and even drawn out in the form of wire, according to General Electric Company

Cunico, which gets its name from components of copper, nickel, and cobalt, has been used during wartime on tachometers, small timing motors, and in gyroscopes, where cunico magnetic screws effect extremely fine magnetic adjustments

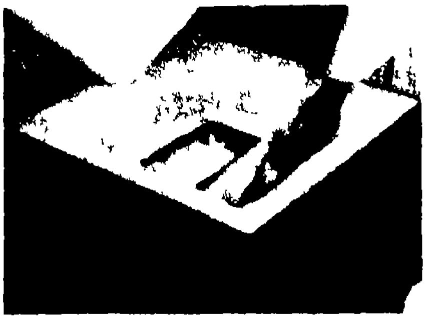
Cunife, made from components of copper, nickel, and iron, has been used as a meter magnet in aircraft devices

Both new metals, because of their versatility, in size and shape, are expected to find applications where magnets have never been able to be used before

PLASTICS FOAM

Insulates Effectively, Is Light, Resists Water and Rot

A newcomer in the low-temperature insulation field, Styrofoam—Styron plastics expanded 40 times—is a pure white, light weight, multicellular mass of foam-like material with low thermal conductivity, good structural strength, and an excellent ability to resist moisture and water The plastics is tasteless, odorless, and has good resistance to mold and rot Also, atmospheric exposure does not affect it adversely and it does not lose its strength at low temperatures Another feature is that it shows no tendency to disintegrate or settle



The physical structure of Styrofoam, according to the maker, The Dow Chemical Company, consists of a mass of small "walled" or sealed cells and it is the continuous wall of the individual cells which prevents water permeation and freezing within the structure

Individual cell walls seal out water, prevent insulating plastics freezing on inside Girl holds equal weights of solid and expanded Styron plastics

TRACTOR TIRES

Take Deeper Bite, Shed Mud, With New Tread Design

Tremendous pulling power even under the worst soil conditions, and automatic shedding of mud and litter as it rolls, are features of a new tractor tire for farm use In addition, smoother riding is reported from the continuous-tread design

Made by Firestone, the tire embodies several innovations in design and construction The wedge-shaped spaces between the curved tread bars continuously widen from the center of the tread to prevent clogging The tread pattern is free of bar ends at the center around which litter can wrap or clog, the tread bars are higher, and an improved cross-section design makes the tread deeper at the shoulders

Pulling power is increased through the cleaning advantages of the design, since a tread with a higher bar depth grips the soil firmly at all times Another feature of the Champion Ground Grip tire is its versatility In loose earth, the deeper bars penetrate to low levels where the shear value of the soil is better, while in firm soils or muddy-top conditions they are forced to greater depths And on paved roads and other hard surfaces, the wider, continuous tread width provides a greater area of contact

Several factors are said to contribute to the longer life of the new tire The bars, triple-braced near the center of the tread to insure stability, are up to 25 percent higher Curving of the bars adds strength and reduces wiping and scuffing and the design contains additional traction bar length ranging up to 73 inches more in the 9-24 size The latter increases traction and affords greater protection for the tire body

New tire tread on front tractor outpulls older tread on tractor being towed

LITHIUM VAPOR

Prevents Furnace Scale Formation on Metal in Process

Heat treating by a new system using lithium is reported to combine the work of two departments in one heat treatng and and surface scale prevention nd removal.

In one production operation, the process is claimed to have cut the cost of removing surface scale on steel forgings, which in many cases runs as high as $12 per ton of work treated, to approximately 65 cents

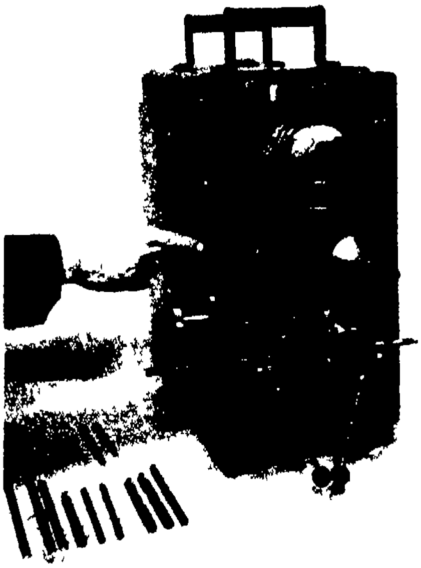
The system, as explained by The Lithium Company, hinges on induction of a vapor form of the chemical element lithium into the furnace's heating chamber Through atomic action, lithium not only prevents formation of scale during annealing, but renders the scaly crust formed in previous forging and heating of the metal harmless for subsequent machining operations Work emerges tempered by the annealing and ready for the machine shop after the one operation The time saved by eliminating the necessity for cleaning is also an important item

Another economy is anticipated in increased tool life Expensive machine tools and fixtures are protected from abrasive particles left on the work by sandblasting and the fact that lithium never allows scale to form means that this danger to cutting tools is eliminated before it stars

FLASH BUTT WELDER

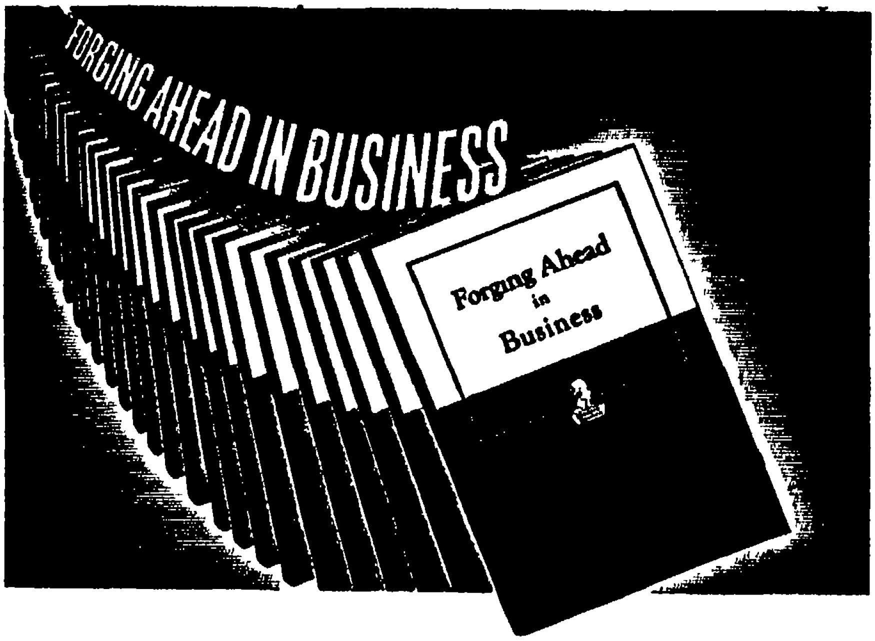
Handles Many Jobs, Uses Standard Current

PROVIDING a quick and economical method of joining most metals so joints are strong and flexible, a new portable welder designed for production welding of bar and round stock up to 5/16 inch diameter is said to be capable of a multitude of uses such as repairing small tools, butt welding tool-bit extensions and shanks, and joining band-saw blades from 1/16 to 1¼ inches in width



Built in grinder, controlled material feed, and an automatic welding cycle

Features of the Do-All Company's welder include a grinder for weld dressing, automatic motor-controlled feed of material making it easy for inexperienced operators to obtain good welds, and a cam-operated lever method of clamping which speeds up the



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Among the prominent industrialists who assisted in the preparation of the Course, which is described in "FORGING AHEAD IN BUSINESS" are: Alfred P Sloan, Jr, Chairman of the Board, General Motors Corp, Thomas J Watson, President, International Business Machines Corp, and Frederick W Pickard, Vice President and Director, E I du Pont de Nemours & Co

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Frankly, this booklet has no appeal for the immature mind It does not interest the man who, for one reason or another, is wholly satisfied to plug along in a mediocre job But, for the alert, future-minded individual—the man with ambition and "drive"—"Forging Ahead in Business" has a message of distinct importance If you feel that it is intended for you, don't hesitate to send for a copy today Simply fill in and mail coupon below

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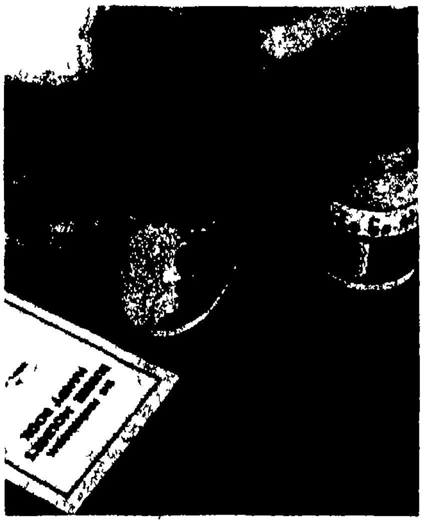
Reproduces Detailed Parts
For Plaster Casting

A WAY of making permanent, flexible rubber molds to form any number of plaster reproductions of intricate art objects, is now available at a very low cost The complete outfit for this work consists of a can of a thin, blue-tinted rubber-chemical mixture for the face of the mold, several brushes, and another can of powdery white particles that provide the durable body of the mold, plus a sample model

No experience or skill is necessary, according to the manufacturer, So-Lo Works, Inc, and no heating or special tools are needed. In use, the first material, called So-Lo Go-Ma Number 1 forms an elastic film over the selected form Several coats are applied with 10 minutes drying between each Powdered So-Lo Go-Ma Number 2 is then dusted on to give the mold its required strength and stiffness, the number of applications determining the eventual thickness of the mold Dried, the mold is removed from the model and is ready to make plaster castings



First step in making mold spreading mixture over object to be reproduced

IDENTIFICATION MARKS

In Metal Parts, Inked
for Improved Visibility

SIZE numbers, steel stamped into metal, are often not readable except upon close examination, now a new machine designated as Acroprinter No 600S has been developed to fill these numbers with black or other color ink or enamel so they can be read at a glance The ink or enamel is saturated into a special grade of felt cut in the form of a ring and set in a brass cup-shaped form that can be rotated from a central axis to maintain a fresh supply of ink

A synthetic, metal-molded, rubber die is used to apply the filling and an adjustable fixture for the variety of parts to be filled is mounted in the stamping position In operation, the user makes a forward movement of the hand operating lever to ink the die, the return stroke accomplishes the filling

Letters inked in two strokes

This machine can also be used for metal-ink printing of size numbers on parts if it is unnecessary to impress the mark into the part Acromark inks are available for marking aluminum, brass, steel, plastics, and other materials

PAINT COLOR

Resists Sunlight Better
With Newly Developed Toner

FADING of chintzes, wall papers, and wall paints should be materially reduced when the new paint color developed in the research laboratories of the Polytechnic Institute of Brooklyn comes into use The sun is one of the greatest enemies of brilliance in paint, dyes, and bright colored inks used in producing many widely used materials, but when processed with the newly developed color, it is said that the materials will have a better chance of a longer "light-fast" life Equally important, the new color costs less than relatively ineffective compounds now in use

The cause for the greater resistance to fading, which is not obtained at the expense of the brightness and color strength, is reported to be the formation of a chromium-Rhodamine B compound which, after its formation, forms a metallic salt of an organic color containing chromium By boiling this metallic salt after its manufacture, it

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was found that while it is usually bright and has an intense color, it could be made more light-fast.

The development of this new method of making colors on a large scale eliminates several expensive processes necessary in the previous methods of development, it was pointed out. This effects a substantial saving in the manufacturing costs with a resultant saving to the retailer and purchaser of the final materials

The new colors, promise to be applicable for all purposes where other toners have been used and some more because of the greater resistance to fading by sunlight

TWO-CYCLE ENGINE

Offers Light Weight, Vertical Power Drive

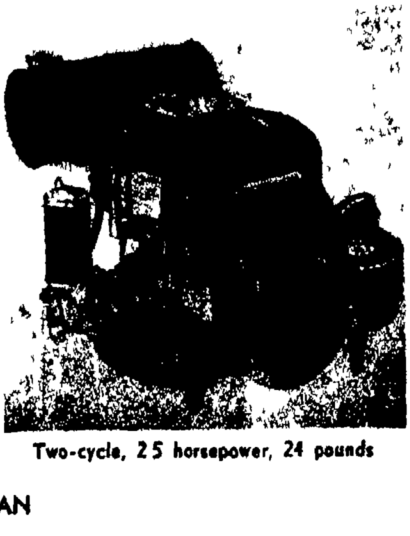
A LIGHT-WEIGHT industrial gasoline engine of the single-cylinder, two-cycle, air-cooled type, weighs only 24 pounds, yet develops a rated 2 5 horsepower at 2500 revolutions per minute It possesses the advantages of the two-cycle engine—small size, simplicity, fast acceleration, and low maintenance—and, in addition, features easy starting and smooth idling

These operating advantages, which are unusual for a two-cycle engine, are said to be due to a "reverse-flow" scavenging system. This design permits the use of flat-top, non-deflection pistons and directional control of the incoming fuel charge is achieved through the use of guide vanes in the intake ports, rather than through piston-top deflectors Hence, detonation resulting from hot spots on piston tops is greatly reduced

The angled intake ports, it is claimed, accurately control and focus the intake fuel flow This results in improved scavenging, better fuel efficiency, better cylinder-wall lubrication, and consistently cleaner spark plugs

The light weight of the Model 1200D engine, is partly due to the two-cycle design and partly to the extensive use of die castings The entire engine, with the exception of the forged-steel crankshaft and rod, and the hardened-steel cylinder insert, is built of high-pressure aluminum-alloy die castings

The engine, made by McCulloch Motors Corporation, is a vertical-crank-



Two-cycle, 2 5 horsepower, 24 pounds

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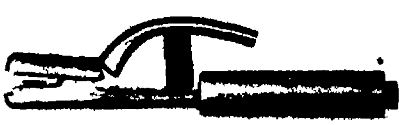
shaft type, and was designed for such applications as vertical pumps, rotary-type lawn mowers, various types of farm equipment, and other devices and implements requiring a vertical power drive

All bearings are the anti-friction type The engine is air cooled and has a flywheel magneto and a rope starter Bore and stroke are two by two inches, displacement is 6.28 cubic inches, and over-all dimensions, including gas tank and spark plug, are 14 6 inches high, 17 8 inches long, and 14 2 inches wide

ELECTRODE TONGS

Thoroughly Insulated and Protected from Heat

A NEW line of manual, arc-welding electrode holders feature durable, molded-laminate, glass cloth Bakelite insulation keyed to the holder casting The tensioning spring seats on fiber upset washers and is protected from spatter by non-binding Neoprene tubing A well ventilated fiber handle, together with a secure cable connection, are claimed to assure a cool-running holder All parts are replaceable



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Known as Twecotong, the line includes full-insulated and semi-insulated models rated at 300 amperes, for ¼ inch electrode capacity, and 500 amperes, for ⅜ inch electrode capacity

DEHYDRATOR UNIT

Controls Temperature and Moisture in Processing Operations

OPERATING on the principle of a heat transfer unit for the heating of both air and gases, as well as for the superheating of steam, a recently developed device handles temperatures up to 1000 degrees, Fahrenheit, maintaining control of exit temperatures within plus or minus 1 degree, Fahrenheit

Called the Goodyer Aridizer, the unit will be of particular interest in food processing and for use in rubber, chemical, petroleum, and printing industries The heating of compressed air for dehydrating is made possible by a bilateral fin design

The effect of dehydrating by compressed air, whereby moisture from the product being processed is removed by absorption with expansion and continuous air movement, permits full control to any degree of moisture content of the product being processed By this method, it is explained that the temperature of the compressed air for a dehydrating process can be considerably lower than if the dehydrating were done by a conventional space-heater type dryer

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al being processed, produce a finished product not discolored from burning and, in food processing, permit the retention of essential food elements.

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WATER SOFTENER

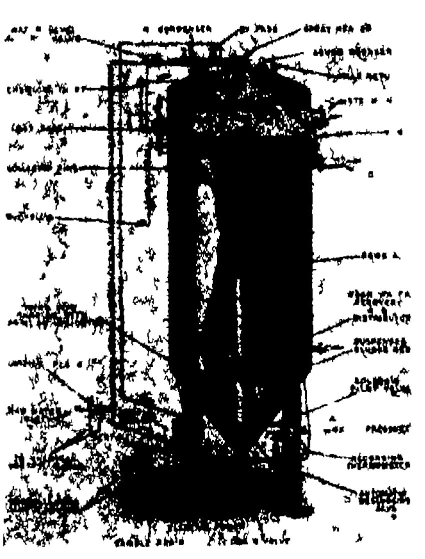
Reduces Chemicals Used, Desludges Automatically

IMPROVED boiler-feed water and substantial savings in chemicals required for water softening are the two chief features of a new type of hot-process water softener described as incorporating a sludge-blanket design This new equipment, developed by The Permutit Company and built in four models for use with various types of steam generators, also reduces the turbidity of softened water, lessens the load on filters reduces the amount of backwashing, and lowers the amount of silica left in the water

In the tank suspended sludge forms a bed which acts as a filter screen for fine particles. This bed coupled with the slow rate of upward flow throughout the full cross section of the settling tank is said to give an effluent lower in turbidity than that obtained in older types of softeners The low turbidity in the settled water places a relatively light load on filters and this in turn produces a corresponding reduction in frequency of backwashing

In addition, the sludge blanket reduces the amount of lime required to soften water, since unconsumed lime is retained in the blanket until it reacts with water hardness In conventional types of hot-process softeners, the unconsumed lime is often wastefully removed during blow-offs with the sludge that has settled on the bottom of the tank

Another unusual feature of this ap-



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CURRENT BULLETIN BRIEFS

Conducted by K M. CANAVAN

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

The Servicing of Television Receivers is a 140-page lavishly illustrated, paper bound book designed to give a clear and easily understandable explanation of the operation of television receiver circuits It is not designed to replace existing handbooks nor is any space devoted to studio problems or historical material Complete emphasis is on receiver and antenna installations and the servicing of television equipment in the shop and home Just enough theory is given to make practice more perfect *Philco Corporation, Philadelphia, Pennsylvania*—*$2.25*

Tough Floor Problems is a folder based on the methods of repair and construction of floors that are subject to acids, greases, oils, and abrasion Also included is information on the patching of spalled concrete, pointing and resetting of brick or masonry, and the repair and construction of foundation and retaining walls *Stonehard Company, 403 North Broad Street, Philadelphia 8, Pennsylvania*—*Gratis*

Hy-Mac Hydraulic Power Units Describing units that may be adapted to produce any motion desired for new machines or for changeover to hydraulics, this ten-page brochure also covers units that are adaptable for grinding, milling, boring, drilling, pressing, piercing, and riveting *Hydraulic Machinery, Inc , 12825 Ford Road, Dearborn, Michigan*—*Request this brochure on your business letterhead*

Protective Strip Coatings of Eastman Cellulose Acetate Butyrate This four-page folder presents in compact detail the preparation and application of continuous, tough coatings to be used for the protection of metal parts of various kinds against corrosion and abrasion in transit or storage Prices of cellulose acetate butyrate, and sources of equipment and ingredients are listed *Tennessee Eastman Corporation, Kingsport, Tennessee*—*Gratis*

Procunier Quick Change Chucks and Collets, listed in a two-color brochure, make it possible to complete a series of operations without removing the work from alinement The way by which tools can be interchanged without slowing the machine is described *Procunier Safety Chuck Company, 18 South Clinton Street, Chicago 6, Illinois*—*Gratis.*

Decker's Airport Guides For those who fly in private planes, be they owners, pilots, or mere passengers, these five pocket-sized guides will be attractive and valuable They are divided into five zones, North Atlantic, South Atlantic, North Central, South Central, and Pacific The guide will give you, for every airport you are likely to visit, all the information you need—exact location, direction of runways, latitude and longitude, facilities such as repair facilities, meals, cabins, and so on. *Decker Air Service, Fairfield, Connecticut*—*$1.25*

DoALL Equals Ten Plus In 22 pages this booklet gives a pictorial time study of metal fabricating short cuts Containing many time-saving ideas, it is designed for shopcoat pocket or tool chest, and is available to shop superintendents, foremen, tool and die makers, machinists, and students *The Do ALL Company, 1301 Washington Avenue South, Minneapolis 4, Minnesota*—*Gratis*

Metro Standard Carbide Tipped Masonry Drills is a four-page bulletin containing descriptions, specifications, and prices on new type drills that are reported to last up to 50 times longer than ordinary steel drills and to speed up drilling work by 75 percent *Metro Tool and Gage Company, 4240 West Peterson Avenue, Chicago 30, Illinois*—*Gratis*

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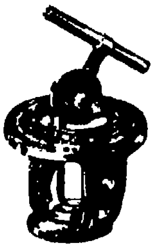

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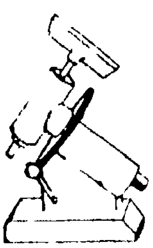

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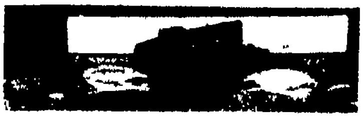

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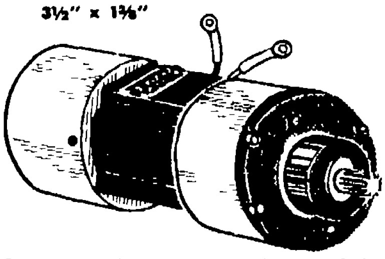

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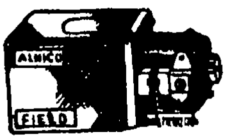

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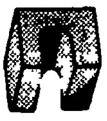

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Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G INGALLS

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IN THE LAST stages of telescope mirror grinding the pencil mark test is sometimes resorted to in an endeavor to bring the mirror and its mating tool to full spherical contact, preparatory to polishing This test is described in "Amateur Telescope Making," page 288, thus "As finer sizes are used, make the simple pencil mark test for sphericity by carefully drying and cleaning tool and mirror, drawing pencil marks across each, working them dry with a few very short strokes, and observing whether they are in contact by noting where the marks are rubbed thin or entirely off"

Your scribe used this test many times on telescope mirrors, had no troubles with it, and offered it in "A.T.M"—since when the mails have brought occasional wails about scratches and sticking mirrors Ralph Dietz, of Pasadena, California, wrote that this test "is bad, a mistake, wrong, and you shouldn't do it." Before removing it from "A T.M" the opinions of others were solicited—still are Dave Broadhead, Wellsville, N Y, says "My vote is to leave it in, as a help to beginners to understand their problem" Fred Ferson, Biloxi, Mississippi, votes "I have used it often and have never traced a scratch to it" On the other hand, H H Selby, in "A T M.A," 117, says "The pencil test is not recommended, due to danger of scratch formation" Why this test should scratch for some, while for others it hasn't scratched yet, remains a puzzle Some have testified that it pulled chunks right out of the glass Can this be true?

To his comment, already quoted, Dietz adds another which opens up a fresh aspect of the same subject "Anyway," he writes, "two pieces of glass, such as a mirror and its tool, when ground together with abrasive between, should not fit each other exactly The bottom disk will have the radius of curvature of the top disk minus the thickness of the abrasive used Therefore, if the pencil lines rub out, something is wrong, not right" This reasoning looks solid, but read on

In Twyman, "Prism and Lens Making," 62, the same consideration is discussed Two disks were ground with fine emery well rubbed down to 0 0002" thickness, then cleaned, dried, and put together They were found to swing very noticeably around the middle These disks had deep curves, *f*/3 Twyman points out that the same phenomenon would not be appreciable with shallower curves

To demonstrate mathematically the truth of this last statement is now our intention We choose a specific mirror, the common 6" *f*/8, its f l 48", its radius 96" How wide will the edge separation between this mirror and its tool theoretically be after they have been worked to a fit with No 600 Carbo between them, washed up, dried, and put together? By the old standby, $r^2/2R$, this mirror's sagitta is 192/9, which figures out at 0 046875000" The average grain size of Carbo 600 being 0 00042" ("A T.M.," 492), we subtract this amount from 96", leaving 95 99958" for the radius of the tool Having a shorter radius, the tool will have the greater sagitta and so the cleaned up mirror will pivot at its center (Theoretically, anyway) We divide 9 again by twice the tool radius, or 191 99916" and get 0 046875205" Subtracting, we get the width of the gap between edges of mirror and tool and this is the amount, an insignificant one five-millionth of an inch, by which "something is wrong" if a mirror of common focal ratio and diameter fits the tool in the pencil test Here it is

tool sagitta	0 046875205"
mirror sagitta	0 046875000"
difference	0 000000205"

Not only that but, on seeing the file of letters and papers involved in the exchange, Broadhead adds this "When the abrasive has been properly worked down at the end of the wet, the grain size will no longer be the 0 00042" it started with but even less"

In passing, note Ellison's cognate argument on page 369, "A T M," where he refers to the loose fit between mirror and tool after a paper polisher 0 01" thick has been removed from the tool Though the gap is here much larger than in the case worked out above, the misfit still comes out only 0 00001" for a 6" *f*/8 mirror, which is far from the "gross error" he terms it It seems probable that Ellison made his statement only on a basis of intuition, as Dietz did, without calculating, and that is what your scribe did when inserting it This, therefore, must come out of "A T.M" Why has no one challenged it?

Incidentally, this department has heard extensively from a group of amateurs in Belgium who were making telescopes as a hobby right through the war and who have been using paper polishers, and they claim "at least as good" results with them as with pitch laps Though most opticians look down the nose at the paper polisher, these Belgian amateurs' claim is so strong that a serious test is in order, not to prove them wrong or even to prove them right but to find the facts Later we hope to find some workers to make these tests and to provide the correct polishing paper and technique Will the reader volunteer as a guinea pig? Working instructions are available

When the above calculations were shown to Dietz he said he was a little surprised at the smallness of the edge gap but still believed the pencil test bad. He also described an experiment which he and many others had often made Grind two disks together, fine grind them, give them a quick shine polish and test them by interference Both will be spherical, as shown also by the shine coming up evenly, but usually four or five fringes—say 1/100,000"—from a fit This is much more than theory calls for but that often happens in shop optics The present discussion, until farther along, is quite frankly, unashamedly, unapologetically concerned with theory for the pure sake of theory, and this is where Dietz took off for an interesting flight He pointed out that, strictly speaking, $r^2/2R$ is the formula for the parabola, not the sphere, though, as he added, it makes no practical difference in the present case of the pencil test. For the sphere we should, he added, use another formula which is

$$MN = AB\sqrt{(AB)^2 - (AN)^2}$$

the appertaining figure being the one in "A T.M," 312 Perhaps, through using $r^2/2R$ so often because its use is virtually always accurate enough to be practical, we sometimes forget this nice distinction

Formulas for the sphere appear in numerous optical works and they appear to differ Some examples

Ellison in "A T.M," 116	$R = \frac{A^2 + D^2}{2D}$
Haviland in "A T M.A," 243	$R = \frac{r^2 + d^2}{2d}$
Hardy and Perrin, 365	$R = \frac{r^2}{2h} + \frac{h}{2}$
Twyman 21	$r = \frac{s^2}{2d} + \frac{d^2}{2}$
Devé 185	$x^2 = y\,(2R - y)$
John Pierce in "A T.M," 312	$MN = \frac{r}{2R} - MN$

After a little standard algebraic-geometric juggling these all turn out to be identical, and more juggling whips this into the form

$$h = R - \sqrt{R^2 - r^2}$$

which is more convenient to apply to a specific problem, even though it involves remembering how to do square root Lazybones can, however, use tables or slipsticks, or resort to a calculating machine This is what your scribe did since it had the advantage of giving correct answers.

It is satisfying to know that $r^2/2R$ (parabola) and the above sphere formula are each complete, concealing no microscopic silent partners

Where do such formulas as those in "A T.M.," 257, and "A T.M," 5, fit into this picture? They don't. These pertain to edge separations between parabolas and spheres that touch (osculate) as in "A.T.M.A," 379, Figure 2 Here the formula is an expansion of the root in the sphere formula by Newton's binomial theorem, which gives $h = r^2/2R - r^4/8R^3 + r^6/16R^5$ Only the

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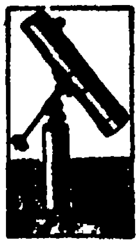

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first two terms are significant in mirror making. This gives depth of glass removed in parabolizing by polishing the outer zones.

What also about things like $r^2/R + r^4/8R^3$, encountered in the literature of optics? These pertain to still another picture, that of longitudinal aberrations along the axis of mirrors, as in the Foucault test, and are a cat of another color, hence, psst, cat, get out and don't confuse the present argument, which will stay on the paraboloid-sphere basis (Anybody who wishes to stir up these particular cats may dig out Prof Wadsworth's article in *Popular Astronomy*, Volume X (1902), 337-348, but, should then hunt up Prof Hussey's sequel article on "The Longitudinal Aberration of a Parabolic Mirror," in *Publications of the Astronomical Society of the Pacific*, Volume XIV (1902), 179-188, because the latter pointed out basic errors in the former caused by misunderstandings concerning fixed and moving pinhole and knife-edge Your scribe also has a file of TN exchanges dated 1933, on the longitudinal aberration cat, which may be borrowed by any who suffer from the mathematical itch There also is an article by Charles G Rupert, in *Popular Astronomy*, 1918, 525-542, entitled "Mathematics of the Reflecting Telescope" These old articles are virtually unavailable to all except those having access to institutional library files and ought, perhaps, to be reprinted)

Before going on, we have been told that it is bad mathematics to call a paraboloid a curve, it being a surface, but a parabola is a curve Pedantry?

If we now apply the sphere formula, the theoretically correct one for an unparabolized mirror, to our same 6" $f/8$ mirror we get—a lot of headaches from doing square root. Your scribe recalled the method but wasn't able to multiply and divide twice alike in trying to spin out the square root of 9207 (mirror sagitta by sphere formula) to a lot of decimal places and then, to get the tool's sagitta, square 95.99958, subtract 9, and take out the square root to an equal lot of places So The Monroe Calculating Machine Company, Orange, N J, was asked to do it on one of its machines These robots don't sweat for two hours over such a problem but sass you right back with the correct answer, and this one came by mail strung out to 17 digits for good measure, these machines being so eager you can't stop them Of the 17 enough are offered below to show the major deviation between results of the two formulas in the present instance By the sphere formula

tool sagitta	0 046886656"
mirror sagitta	0 046886450"
difference	0 000000206"

Now let's subtract the parabola formula's findings from the sphere formula's findings

as sphere	0 000000206"
as parabola	0 000000205"
that big gap	0 000000001"

So we've found at last that the *correct* formula gives us a billionth of an inch more than the "wrong" one. Let's celebrate.

Yet let's not celebrate too hard, for that submicroscopic gap grows mightily with shortened focal ratio and soon enters the realm of the entirely practical. C. R. Hartshorn, Los Angeles, to whom the above data were shown, has explored some of the effects of varied focal ratio on the use of the parabola formula instead of the sphere formula and worked out (didn't lean on any lazy man's crutch) the following table for 6" mirrors of eight focal ratios

f	R	$R-\sqrt{R^2-r^2}$	$r^2/2R$	diff.
8	96"	046886"	.046875"	000011"
7	84	053589	.053571	.000018
6	72	.06253	0625	.00003
5	60	.07505	075	.00005
4	48	09384	09375	00009
3	36	.12522	.125	.00022
2	24	.18824	1875	.00074
1	12	.38105	.375	.00605

Hartshorn emphasizes that this table is for 6" mirrors alone Others are not in direct proportion Its practical purpose is to indicate just where it is time to switch to the sphere formula—for example, on a Schmidt primary Hartshorn summarizes his findings thus "Those who think they can read the knife-edge to 0 001" [Chance for another long-winded argument here—see "A.T.M.A.," 21, line 11—*Ed*] may start brushing up on their square root at about $f/2$ This checks nearly enough with an old letter from Kirkham "By calculation it is found that the inaccuracy from using $r^2/2R$ is negligible down to $f/3$" Broadhead, in working on his deep-curved Maksutov telescope wrote, "I found at the outset that $r^2/2R$ was not close enough and avoided a very serious source of error on these telescopes by using the sphere formula" And, by the way, Broadhead nearly finished his Mak, had to set it aside for other work, as have several others

Shown the above findings, Frank R Varela, Tenafly, N J, worked up the following table for two focal ratios and three apertures

	f	$R-\sqrt{R^2-r^2}$	$r^2/2R$	diff
8"	2	0.250989"	0.25"	0 00099"
8"	4	0 12512	0.125	0 00012
10"	2	0.313727	0 3125	0 001227
10"	4	0.15640	0.15625	0.00015
12"	2	0.376478	0.375	0.001478
12"	4	0.187680	0.1875	0 00018

"These figures," Varela states, "were computed with 7-place logs and the sixth significant figure may be accepted as correct. As happens where three variables are involved, the errors do not follow a simple law, but must be referred to three planes of reference They do indicate a rapidly increasing error from using $r^2/2R$ as the focal ratio is shortened An examination of this table and Hartshorn's indicates that a not too accurate rule can be applied that the error increases inversely as the cube of the focal ratio"

Early in the above article your scribe said the pencil mark test hadn't scratched yet for him The article was written, set aside for a long time and almost forgotten A pair of 10" mirrors were made, and on one of them the pencil test pulled little hunks right out of the glass Exuent test, with slow, sad music, Dietz and Selby grinning

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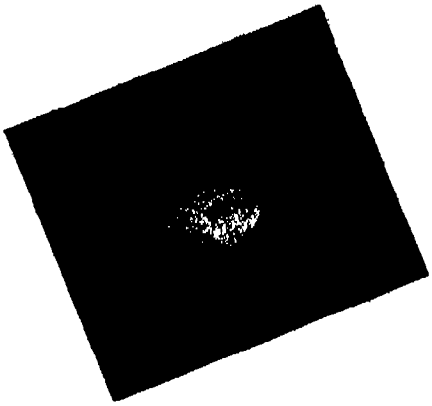

INDUSTRIAL DRAMA Synthetic sea water at a temperature of 100 degrees Fahrenheit forms a highly corrosive mist in this salt spray cabinet used in the laboratories of the Gulf Oil Corporation for determining effectiveness of rust preventive compounds Here the effects of months of normal exposure are compressed into days

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50 Years Ago in SCIENTIFIC AMERICAN

(Condensed from Issues of February, 1897)

SUPPLY AND DEMAND — "In the open market, the price of a commodity is practically the cost of production plus a fair business profit If this result is not obtained, a business languishes or expires If profits are abnormally large, capital is attracted and competition set up, and the availability of capital now brings about the modern fact that increased demand causes reduced prices"

POWER DRILLS — "In these days of labor saving machinery there are few fields in which greater ingenuity has been shown than in the manufacture of portable machines for boring, drilling and similar shop and yard work A type of very compact portable electric drilling machine has been at work at the Arsenal in Trieste for over three years, and has given great satisfaction It will be seen from the illustration that the motor, with its gearing, is pivotally suspended in a yoke which is carried on a suitable hand truck or carriage When any holes have to be drilled in a piece of work, the portable drill is wheeled to the spot, and the wires attached In this way the time formerly occupied in carrying the work to the drilling machine is saved. As instances of the economy of these machines, we are informed that where ten flexible shaft drills were formerly used in the boiler shop, four electric boring machines now do the same amount of work, with less hands than were formerly necessary In the fitting shop they have saved much time and money in the handling of heavy work."

FIRE ENGINES — "There is now being constructed for use by the Boston Fire Department a horseless steam engine, of great size and power, having a contract capacity of 1,350 gallons of water per minute, but the builders, in view of recent tests, are confident that this engine will throw 1,850 gallons of water per minute."

WELD STRENGTH — "Some experiments made at the engineering laboratory of the University of Michigan to determine the strength of welded joints are especially interesting Of a number of the specimens tested not one broke in the weld, as some of these were slightly larger at the weld, a new set of specimens was prepared and a cut taken from each in the lathe to reduce the piece to a uniform diameter throughout its length From each bar four specimens were prepared, one solid, one lap welded, one butt welded, and one split welded The results show that only two specimens, both lap welded, broke at or near the weld, the strength in no case departed widely from the strength of the solid parts."

SUBWAY — "A deep tunnel scheme for rapid transit between New York and Brooklyn is recommended by a commission which was appointed by the mayor of the latter city to arrange a plan for improving rapid transit facilities on certain of its streets The plan proposed contemplates an electric line (partly in tunnel and partly on an elevated structure) from Cortlandt Street and Church Street, New York, to Ralph Avenue, Brooklyn"

NO METRIC SYSTEM YET — "The United States years ago legalized the use of metric weights and measures, but did nothing to enforce their use Just now her merchants are working to increase their trade with the countries of Central and South America, and as all these use the metric system, there is a growing pressure for its formal adoption by Congress In America the local weights and measures used in the various States are particularly numerous and confusing, and the substitution of the uniform French system for all of these would be of inestimable benefit"

SUGAR — "As to our country, it is declared that we spend annually about $135,000,000 for sugar, of which more than eight-tenths goes to foreign countries. We consume one-fourth of the exported sugar product of the world Fifty years ago, 94 percent of the annual sugar product of Cuba found a market in Europe, now that proportion of its production is sold in the United States"

100 Years Ago in SCIENTIFIC AMERICAN

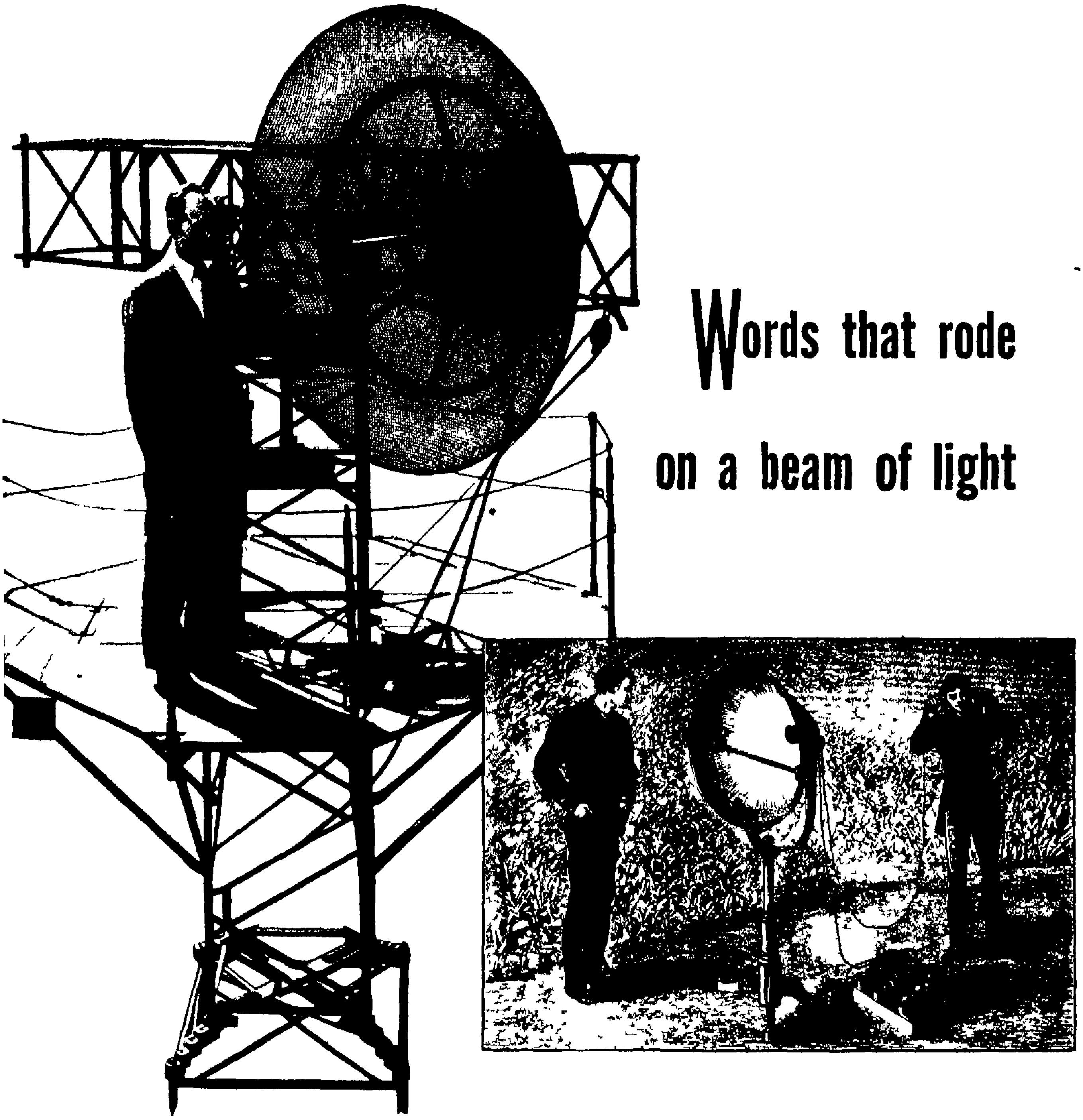
(Condensed from Issues of February 1847)

FACTORIES — 'Within a few years, there have been erected at Cohoes five cotton mills, two extensive axe factories, one large drawer manufactory, and other smaller factories which employ in all about fifteen hundred hands The village is well spoken of for the excellent morals and steady industrious habits of its citizens"

PANAMA CANAL — "Prince Louis Napoleon is about to proceed to Central America, for the purpose of putting in progress the work of uniting the two oceans The celebrated geographer, Professor Charles Ritter, has communicated to the geographical society of Berlin, the project of the Prince, which it appears, he conceived and prepared during his imprisonment at Ham"

INDIAN COTTON — "The cotton manufactory in India is not carried on in a few large towns, or in one or two districts, it is universal The growth of cotton is nearly as general as the growth of food, everywhere the women spend a portion of their time in spinning, and almost every village contains its weavers, and supplies its own inhabitants with the scanty clothing they require Being a domestic manufacture, and carried on with the rudest and cheapest apparatus, it requires neither capital, mills or an assemblage of various trades"

LOCOMOTIVE — "A locomotive has been constructed in South Wales, with eight wheels, all connected, thus constituting eight driving, (or traction) wheels Its capacity of traction is of course proportionately greater than that of engines of ordinary construction."



Words that rode on a beam of light

If Alexander Graham Bell could look at the microwave antenna in the illustration, how quickly his mind would go back to his own experiments, 67 years ago!

For in 1880 the inventor of the telephone had another new idea. Speech could be carried by electric wires, as Bell had demonstrated to the world. Could it be carried also by a *light beam?*

He got together apparatus—a telephone transmitter, a parabolic reflector, a selenium cell connected to hand phones—and "threw" a voice across several hundred yards by waves of visible light, electromagnetic waves of high frequency.

Bell's early experiment with the parabolic antenna and the use of light beams as carriers was for many years only a scientific novelty. His idea was far ahead of its time.

Sixty years later communication by means of a beam of radiation was achieved in a new form—beamed microwave radio. It was developed by Bell Telephone Laboratories for military communication and found important use in the European theater. In the Bell System it is giving service between places on the mainland and nearby islands and soon such beams will be put to work in the radio relay.

In retrospect, Bell's experiment illustrates once again the inquiring spirit of the Bell System.

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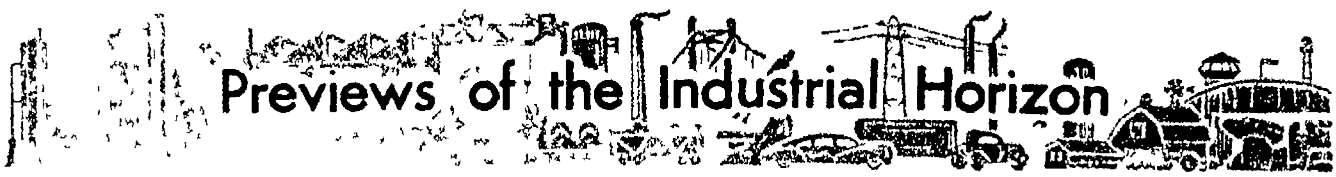


Previews of the Industrial Horizon

By A. P. Peck

PRELIMINARY REPORT ON BRAZIL

A number of factors have combined to prevent publication this month of the promised report on Brazilian industry. Here, however, is a preview from the writer's notes and other source material:

Brazil, covering an area greater than the United States, is today in about the same stage of industrial development as this country was some 50 years ago. But Brazil has the advantages of available knowledge and of being able to profit by mistakes made by others. Actually, Brazilian industry—other than in coffee, sugar, and the like—is only about 15 years old. In her factories it is incongruous to see antique machinery (obtained second-hand from other countries) working side by side with an occasional piece of fine precision equipment—and hand labor doing most of the work at that!

On the natural resources side of the picture, another parallel to the United States can be drawn, with a time span of 75 years, more or less. Much of the country remains unexplored. Precious metals deposits have been worked but even their approximate extent is as yet unknown. The same goes for coal, oil, bauxite, and so on. Much of Brazil is still inaccessible, roads are few and not too good. Railroad mileage is small and equipment is not standardized. Travel by air offers the best possibility of getting around the country, and wide-awake Brazilians are taking full advantage of its opportunities.

All in all, there looms south of the equator a rich and as yet undeveloped land which promises to go through much the same stages of industrial development as has the United States. And as it marches steadily toward that horizon it will offer tremendous possibilities for industrial co-operation with the United States—in ways that will be developed in more detail in a future issue of Scientific American.

OIL IN THE HOME

Some measure of the future possibilities of oil heat for domestic purposes—recently given a shot in the arm by the combined circumstances of the coal strike and renewed production of oil burners—is found in the following figures: Today there are about two and a half million domestic oil burners in use. By 1950, according to an engineer of Standard Oil Company (N. J.), there will be nearly four million units in service and close to five million by 1965. Here are great possibilities not only in oil-burner manufacture and fuel production, but also—and most important of all—in research on improved efficiency of fuel production and consumption.

PORCELAIN ENAMEL'S FUTURE

If a present trend continues, porcelain enamel over steel bases is going to be found in many more places in the home of the future than merely the kitchen range, sink, and refrigerator. Some of the things for which horizon-eyed architects are considering the use of this material include shutters and other exterior trim, window boxes, prefabricated cellar stairs, chimney tops, and outside fireplace chimneys. Features of porcelain enameled steel which lend themselves to these and other uses are its dimensional stability, speed of production in the fabricating plant, possible variety of permanent colors, and economical up-keep.

THE FOREMAN IS IMPORTANT

In these days of unionism, job evaluation, and so on, the foreman in the plant is all too likely to feel that much of his authority has been removed, that he is being kicked around, that he is obsolete. Despite this feeling on his part, he is still one of the most important cogs in the human side of industry. He is the go-between, the representative of management to the men under him, the one who can keep his men happy or permit them to become disgruntled. And if he is unhappy, his men will be unhappy.

One thing that industry must do for its foremen is to let them in on the fundamentals of industrial economics. Show them how plant production is basic to their own—and the other workers'—daily lives. Be sure that they understand that they eat regularly because someone else buys the goods they produce—and that they won't eat quite so often if production falls off. Then, too, emphasis must be placed on the foreman's importance as a builder of worker morale. He can do far more to benefit the company by distributing praise to his men where it is deserved than by wielding a figurative whip.

All this is admittedly over-simplified. References to more detailed sources regarding the importance of foremen, and how to develop it, on request.

STRAWS IN THE WIND

Surveys of strike-free plants—not quite so rare as perusal of newspaper headlines would seem to indicate—show that incentive plans work well, that a bit better than average pay for workers keeps down unrest, and that a personal touch between management and workers pays out in the long run. . . . Refrigeration in all its phases—home refrigerators, frozen food lockers, and hot-weather home-cooling—is a rapidly expanding industry which has a virtually unlimited future: it extends also into new and improved mobile units for highways and railroads. . . . Attempts are being made to exercise Federal control over production of lumber from small forest holdings—highly important in our natural resources picture: better results can come through education of owners in the importance of adequate conservation methods, placing the emphasis on a dollars-and-cents profit basis for the long pull.

Scientific American
FEBRUARY • 1947

Portable Geiger counters in use in atomic research laboratory at Oak Ridge

RAY-TRACER of Atomic Fission

By SAMUEL BURGER

Developed 40 Years Ago as a Tool of Pure Science Research, the Geiger Counter Is Just Now Coming Into Its Own Coupled With Man-Made Radioactive Materials It can Locate Insidious Cancer for the Surgeon's Blade, Point Out Potential Oil Pools Deep in the Earth, Stand Watch In Steel Mills, or Trace Chemicals Through Complex Processes

IT WAS hours after the explosion of atomic bomb Number Four over the target fleet at Bikini The odd-shaped, lethal cloud had drifted away upon the east wind, but grim Death still swam in the blue lagoon, walked the decks of the battered and burning ships, sifted like a ghost through the steel decks and bulkheads of ships that showed hardly any blast damage—Death in the form of the dread gamma rays released by plutonium fission

Hundreds of goats, pigs, and white mice had already been pierced by that unseen blade They had felt no pain, yet the wound was mortal. No power on earth could have saved their lives They were as surely doomed as the thousands of Japanese fatally injured by radioactive rays at Hiroshima and Nagasaki

Now men had to venture into that arena of burning ships and unseen death, for the fires raging on the stricken vessels had to be put out. But how could the fire fighters know which ships were safe, and which were still a source of the fearful gamma rays?

The answer was the Geiger counter, here used in the form of a black oblong box about the size of a miniature portable radio, and worth knowing more about if one proposes to understand, and to survive, the atomic age Equipped with needles, dials, and a set of earphones, it measures the amount of radioactivity in the air, whether natural or man-made If you put on its earphones, you will hear an irregular chorus of sharp ticks, like

Linlithgow Library.
Imperial A [illegible] rch Institute

a night full of metal crickets. The more frequent the ticks, the greater the radioactivity.

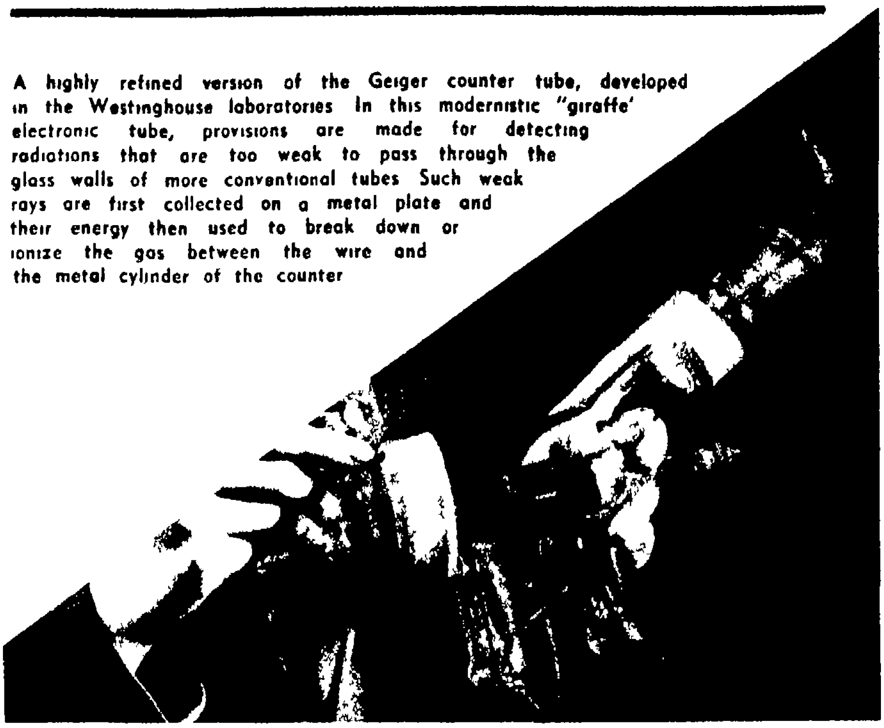
At Bikini the firefighters were preceded by small boats manned by the "monitors" of the radiological safety-party. Clad in olive drab fatigues and steel helmets, their only real protection was the Geiger counter which each man clutched tightly and consulted often. From the press ship, I watched them as their launches moved over the contaminated water. At the bow of each boat stood an officer, taking frequent readings.

STILL "HOT" — When the correspondents were at last allowed to visit the *Nevada* and other target vessels, we found radiological safety parties still at work. They were ferreting out and marking in angry warning red, objects aboard the ships which were still "hot." I remember standing near some cans of Foamite when a monitor approached. He went for them straight as an arrow, consulted the dial on his Geiger counter, and looked at me queerly.

"How long have you been standing here?" he asked.

"Only a few minutes," I replied, with sudden trepidation.

"Better move on," he said shortly. "The chemicals in these cans are 'hot' enough to give a man a graveyard dose in four hours."



A highly refined version of the Geiger counter tube, developed in the Westinghouse laboratories. In this modernistic "giraffe" electronic tube, provisions are made for detecting radiations that are too weak to pass through the glass walls of more conventional tubes. Such weak rays are first collected on a metal plate and their energy then used to break down or ionize the gas between the wire and the metal cylinder of the counter.

Not long after the bomb went off, the winds of the upper air, five miles above the earth were thrusting a lovely, gold-tinted cloud out to sea. Innocent though it looked to the casual eye, each tiny particle of dust and moisture in it was alive with killing energy.

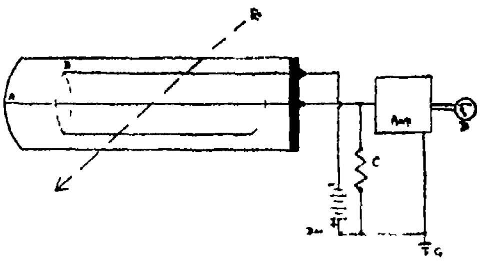
The pilotless drone planes which had carried Geiger counters into the heart of the cloud returned to their base too "hot" to handle. Such was the potency of the cloud. And a sudden shift in the unstable Pacific winds might waft it into well-travelled air lanes. Or, worse still, changing atmospheric conditions might precipitate it to earth as death-laden rain over a populated island. So the deadly cloud had to be trailed, which was not easy in a sky full of natural clouds. More difficult yet was following it at night. There was great danger that the planes stalking the cloud might blunder through the blackness into the very teeth of their quarry.

Again, the Geiger counter proved its unique value. Scout planes equipped with counters rode herd on the atomic cloud until it was safely dissipated.

Using a Geiger counter to check possible radiation leakage from a lead container used for transporting radioactive materials in the laboratory

MOST SENSITIVE — Wherever you may be—indoors, outdoors, on a mountain top, or in a bank vault—the air about you is figuratively whizzing with bullets of unbelievable energy and speed. These infinitesimally tiny missiles, which pierce your body harmlessly (only because they are so few), are for the most part cosmic rays—space bullets shot at us from a source believed by some to be exploding atoms in the distant stars. Fortunately, the earth's atmosphere absorbs most of these bullets, otherwise, animal life on this planet might never have evolved. The Geiger counter, sensitive to cosmic rays, serves also to detect the lethal rays unleased by the explosion of an atomic bomb. Yet it was designed, not as a watchdog for the epoch that began with Hiroshima,

HOW THE GEIGER COUNTER WORKS



IN ITS simplest form the Geiger counter tube (sometimes called the Geiger-Muller counter) consists of a glass envelope enclosing a thin central wire, A, and a metal cylinder, B made electrically negative by the battery shown Before the glass envelope is sealed off, gas at low pressure is introduced—one of the 'noble" gases usually argon When a ray R, from a radioactive source passes through the counter it ionizes the gas, giving rise to both positive and negative ions as well as electrons Through a 'multiplication process, brought about by collisions between electrons and gas molecules as well as the release of electrons from the cylinder, a large surge of ions is built up until the wire and cylinder approach equal potentials At this point ionization no longer occurs and the electrons on the wire pass through the resistance, C to ground The counter is now ready for the next ray with the difference of potential re established The current surge in the external circuit is amplified to operate an indicator, D, which may be a meter a mechanical electronic counter, or an earphone Time interval for each operation of the tube, measured in micro seconds, is governed by the value of the resistance and the distributed capacity of the counter tube itself

but as a tool of pure science research About 40 years ago, when the great British physicist Rutherford was engaged in his historic studies on the newly discovered radium, his young German assistant Hans Geiger devised an instrument that would count the number of particles given off by radium It was, and still is, the most sensitive instrument ever invented by man for the detection of radioactivity

But even Hans Geiger never guessed how versatile a tool of science he had created Scientists whose life work it is to track down the secrets of our solar system put the Geiger counter to work measuring the cosmic rays which constantly bombard the earth Physicians use it in the fight against cancer and other deadly ills, petroleum engineers lower it down drill holes to map oil structures far below the surface of the earth, geologists use it in their search for uranium and other radioactive minerals It is essential to nearly every branch of the young science of "nucleonics," which promises much for the future of all science and industry

Recently, I had the privilege of talking with Dr John R Dunning who split the uranium atom in January, 1939 and one of his colleagues, Hugh A Glassford, in the underground laboratories at Columbia University From Glassford I learned to think of a Geiger counter as a delicate electronic drum—a drum so sensitive that a particle of matter smaller than the atom will cause it to emit a sound This sound, enormously magnified, is heard in the operator's earphones as a sharp "tick ' Each tick means that another incredibly minute alpha, beta, or gamma ray has passed through the instrument Even the infinitesimal amount of radium on your watch dial will cause the Geiger counter to tick vigorously

It is never silent Even when no man-made radioactive material is present, it will still be busy "picking up" cosmic rays at the rate of about one a second

COUNTER AT WORK — With a long, tweezer-like tool Glassford extracted a tiny sample of uranium from a lead storage box and carried it to a small lead vault in which a Geiger counter was set up As he prepared the instrument, Glassford—who has developed many varieties of counters himself—explained that although counters equipped with earphones were valuable in warning of dangerously high radioactivity, they were not accurate enough for exacting research

He carefully deposited the uranium within the lead vault, and spun the door closed Then, stepping to a machine which resembled an oversize walkie-talkie, he began to flick switches "Let's set the scale to 32 This means that the machine will count 32 particles, and then send them along *all as one* to the dial. Ready? Here we go!"

He started the machine Almost at once a light flashed "There's one," he cried Another light flashed, lower down the scale, beside the number four 'There's four more" Now the lights were flashing up and down the scale at such speed that no eye could follow them Meanwhile, the needle on the dial advanced one notch each time 32 particles were counted So fast was the count that within a few seconds the needle had registered a final count of 3188

For emergencies, for the dangerous aftermath of such tests at those at Bikini there are Geiger counters which measure the total amount of radioactivity in the air at any given moment, almost instantaneously Without such warning counters the atom bomb tests would have cost lives—or not been held at all

Geiger counter (tube at left, mechanical recorder at right) set up in the laboratories of Socony-Vacuum Oil Company, Inc Possibilities of these instruments are being fully explored for use in geological surveys and chemical processes

DISEASE FIGHTER — In recent years the Geiger counter has linked hands with the atom to fight diseases whose origins are still obscure and to blaze new pathways in industrial illuminating source by the phototube, the change in phototube current caused by dust in the intervening air is small compared to the constant current corresponding to clean air This is true unless the dust densities are excessively high or the light path exceedingly long This results in a loss in effective sensitivity

To minimize this difficulty, a lens might focus the light on a small absorbing target near the phototube thus protecting the latter from direct rays Another lens could then direct diffracted and reflected light to the phototube cathode But in a dust-laden system of this sort lenses are generally undesirable since dust collecting on them scatters light just as does airborne dust These factors and other practical considerations favor the adoption of the indirect-viewing method

Using indirect viewing, the illuminated dust particles are viewed by the phototube at an angle to the illuminating beam An optical system here would serve only to increase the sensitivity of the phototube system This same function can be performed by a suitable electronic amplifier, which is more desirable than an optical system

If the dust has a random particle-size distribution ranging from larger to smaller than the wavelength of the incident light, the light scattered normal to the beam would be made up of that due to reflection from the larger particles and that due to absorption and reradiation from particles smaller than the wavelength of the light used Too, the particle distribution before the air passes through the cleaner would differ from that after cleaning, because any air cleaner is selective with regard to the ease with which it collects particles of a particular size Thus the ratio of reflected to reradiated light would change after air cleaning

• LOOKING AHEAD •

More efficient air-conditioning systems through precise measurement of dust removal Determination of filter efficiency as a factor in design More knowledge about the size of dust particles removed by a given method

SELECTIVITY — For these and other reasons, the types of dust were restricted to those with particle diameters all larger or all smaller than the wavelengths of the illuminating radiation to which the phototube is sensitive If the phototube current is to be directly proportional to the number of particles in the air, then they should also be sufficiently similar in size to make the selectivity of the cleaner negligible over the range of particle sizes

The major design factor in air-conditioning testing is to have the intensity of illumination of the phototube cathode proportional to the number of dust particles in the air Then if the relation between phototube illumination and phototube current is known, the phototube current as amplified and shown on a meter is a direct indication of the number of particles per unit volume of air

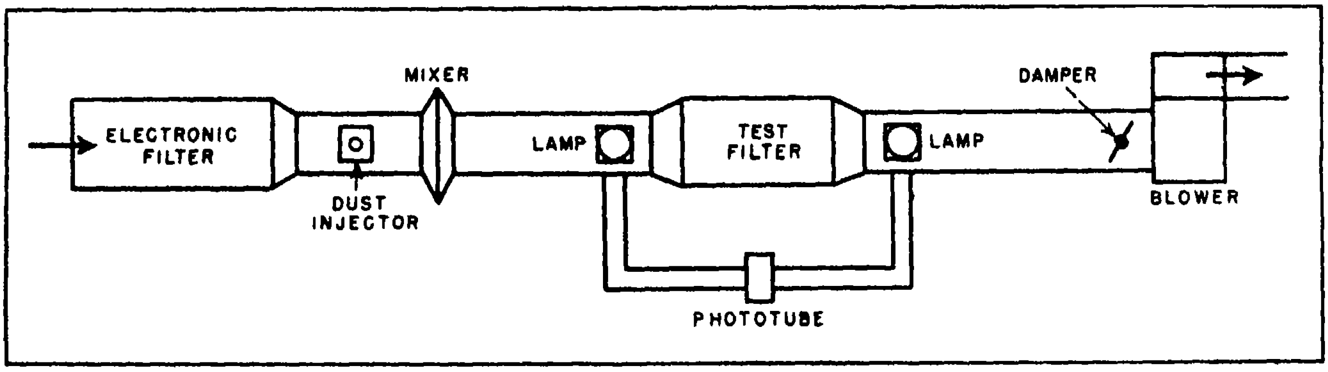
Due to the high sensitivity of the response of the multiplier type of phototube to variations of electrode voltages [illegible] power supply with good regulation is imperative

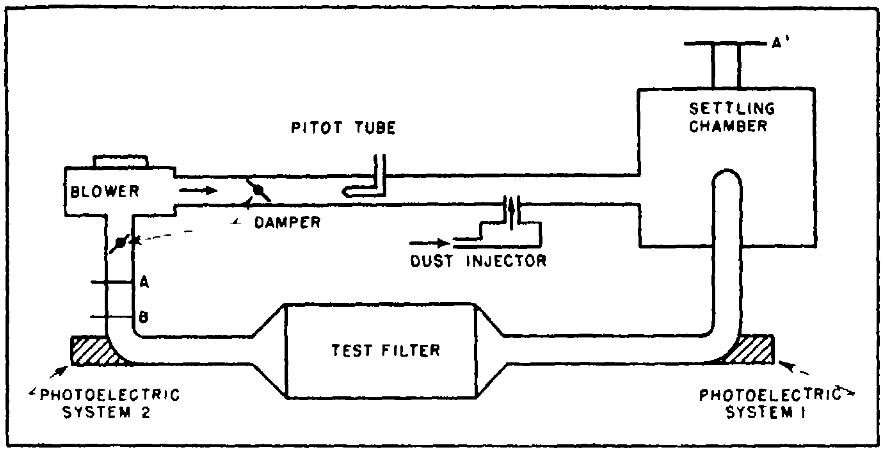
The original dust injector system failed to give an entirely uniform feed at the low dust levels desired and a metering type of dust injector was finally adopted This arrangement is also illustrated In this, the dust content of the air is varied by changing the speed of rotation of a notched cylinder Efficient filters clean the intake air to give a zero dust level The whole measuring system is on the low-pressure side of the blower to facilitate the introduction of dust or smoke

A single unit of phototube and associated electronic equipment is used to observe the dust level on both sides of the cleaning device A panel-type meter is used as an indicator

The air velocity is maintained at a sufficiently high value to minimize the retention of particles on the duct walls A value of 6 5 feet per second was originally used, but experience indicated the advantage of somewhat higher velocities

ACCURATE RESULTS — The final set-up gives quick and accurate results Indication is continuous and shows the relation between any one of several variables and the quantity of dust in the air When working in the region of dust levels where the phototube response is linear, efficiency readings are quite accurate, since they are obtained from relative readings The technique is also applicable to factory





First set up (left) for testing electronically the efficiency of air conditioning filters was modified until the final model (above) had evolved

checking of air filters, since the equipment, once adjusted, will provide efficiency ratings simply and rapidly in the hands of an untrained operator

The electronic dust meter is an answer to the problem of the air-conditioning industry, confronted with the task of testing and rating air-cleaning devices It gives quick but accurate measurements for plant use Previous measurement techniques did not give a direct and instantaneous indication of cleaning efficiency at all times and highly trained workers were necessary

One older technique of measuring the amount of dust in air involves using a piston to pump the air onto a viscously-coated slide The size and number of particles deposited per unit area are determined with the aid of a high-power microscope This requires manual preparation and handling of the slide, adjustment of the pump orifice, and other complications Considerable time is required to make the measurement and a highly trained worker is required At the same time, errors due to optical and mechanical discrimination against small particles are bound to creep in and the always-present human error in making the count introduces another variable that must be reckoned with

A somewhat similar approach to the problem is to determine the increase in weight of the coated slide This method reduces the human error, but in such a weight determination there is no way of knowing whether a given weight represents one particle 1000 units diameter or 1000 particles having one unit diameter

A third method of testing dust-laden air is to force it through some filtering material such as a cloth at a uniform rate The increase in weight or coloration of the filter over a given period of time then gives an indication of the dust content of the air However, this method is also long and cumbersome

The disadvantages of these methods have been overcome by the electronic method, another example of one new industry aiding another

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DISHWASHER SOAP

Kept at Proper Level by Electronically Controlled Valve

A DETERGENT dispenser for dishwashing machines uses electronic circuits for constant and automatic regulation of the concentration of detergents in the wash solution Operation of the device depends upon the change of conductivity of the solution which takes place when the concentration changes

Basically the unit consists of an A C resistance bridge and an electronic amplifier and rectifier One arm of the bridge is the resistance between two electrodes suspended in the cleansing solution, and the other arm consists of a cylinder containing a solution whose resistance approximates that which should exist between the electrodes in the tank

A decrease in the concentration of wash-tank detergent produces an increase in resistance in one arm of the bridge This unbalances the bridge and applies a signal to the amplifier controling a magnetic valve that opens only when the bridge is unbalanced The valve is connected to the water input of the dishwashing machine so that opening it permits a small auxiliary tank to feed a super-saturated solution of detergent into the main tank When detergent sufficient to rebalance the bridge has been added to the wash tank, the proper electrical conditions are established and the valve is closed

ELECTRONIC DYNAMOMETER

Puts Production-Line Car Engines Through Paces Quickly

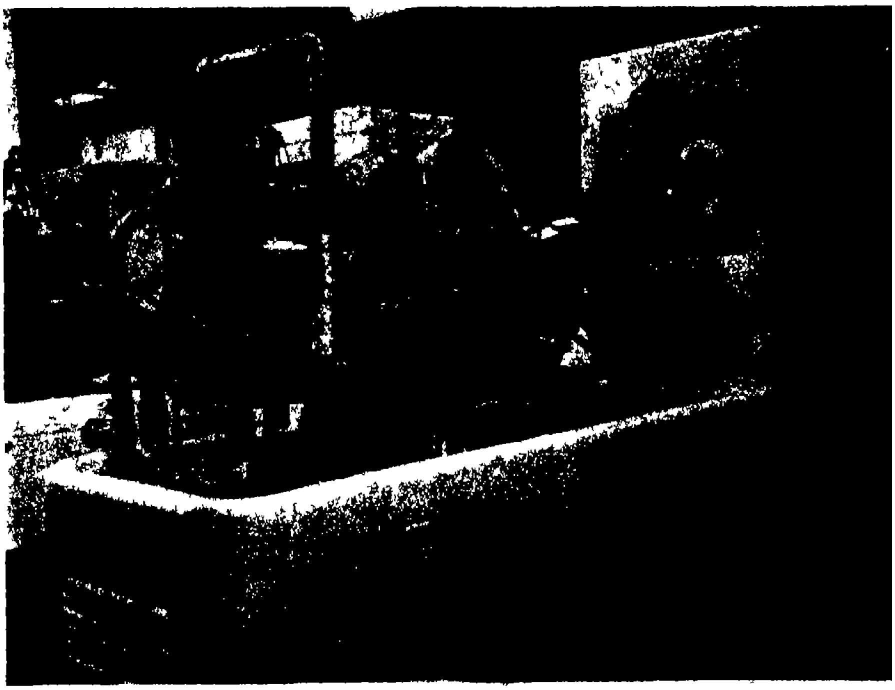
PROVIDING an automatic means of testing and adjusting newly built car engines, electronically controlled dynamometer test stands now take the place of the old block test which required an hour and a half, and the old dynamometer test, which took an additional ten minutes, not counting time to transfer the engines between stands The time required for fully testing an engine has been reduced to 20 minutes

Each test stand contains a generator and electronic controls that operate an instrument panel Adjoining it is the base on which the engine is mounted Fuel, water, oil, and exhaust-gas lines are concealed underground

The engine operates for five minutes at an idling speed of 500 revolutions per minute, with filtered oil constantly flushing through the crankcase Then the electronic controls apply a half load on the generator, the throttle opens up, and the engine runs for 12 minutes at half load During the first seven minutes at half-load, externally supplied oil continues to flush through the crankcase, while a filtering system takes out any metallic traces remaining from the manufacturing process The oil drain is then closed automatically, the crankcase is filled to operating level and the last five minutes of the half-load test is run with oil circulating within the crankcase

The engine runs at full load for the final three minutes of the test During the run, the operator tightens all connections and cylinder-head studs, and an inspector checks each engine

Flashing lights show instantly whether the oil pump, water pump, and thermostats are functioning and the ignition timing is correct At the end of the 20-minute run the engine is shut down and oil and water are drained automatically Five minutes later, the engine is on its way to be installed in a new Dodge



Within 20 minutes a car engine is thoroughly tested—electronically

Fugitive Fluorine

Chemists Have Finally Succeeded in Taming Fluorine, the Most Unruly of the Elements. Now this Corrosive Gas Is the Principal Building Block of New Plastics, Lubricants, Insecticides, Fire Extinguishers, and a Potentially Large Host of Other Useful Materials

FLUORINE is a gas that is so reactive that even at −420 degrees, Fahrenheit, just a few degrees above absolute zero, it explodes upon contact with liquid hydrogen. Large chunks of wood will spontaneously burst into flame in a fluorine atmosphere, and steel wool will burn brightly in the gas.

It is no wonder, then, that chemists worked in vain for over 75 years to isolate the element from its compounds. A French chemist, Moissan, produced the gas in 1886, but it proved so unmanageable that little was done with it until recent years.

Unimportant industrially as the elemental gas has been, some of its compounds are extremely important. Cryolite, for example, which is a complex fluoride of sodium and aluminum, is essential to the production of aluminum and is also used as an insecticide. Fluorspar, a calcium fluoride, is the raw material for hydrofluoric acid, widely used in the petroleum industry to increase the yield of gasoline from crude oil. Sodium fluoride is a familiar enemy of rats and roaches and the silicofluorides are used in ceramic manufacture.

A few synthetic fluorine-containing compounds have been known for more than a decade under the tradename Freon. Because they are stable and non-poisonous in addition to having desirable physical properties, they are ideal refrigerants.

An insecticide widely used in Germany was difluoro-diphenyl-trichloroethane, a fluorine analog of DDT, which is dichloro-diphenyl-trichloroethane. It is said to be even more effective against some insects than DDT.

Fluorine is not new then, in the sense that until now it was totally unfamiliar. But the few fluorine compounds which have achieved industrial stature are only a very small proportion of the possibilities. What is new and important is the extent of the work now being carried on. Chemists have pressed on past the obstacles in the way of winning and handling the tricky gas, so that what was formerly a passing acquaintance has ripened into intimacy.

GETTING THE FLUORINE — In 1942, all the fluorine producing facilities in the country could not have made more than a few pounds a day for experimental purposes, three years later production was measured in tons a day. The atomic bomb program, which used great quantities of fluorine to make uranium hexafluoride, was responsible for much of the spectacular boost. Uranium hexafluoride is unique in that it vaporizes at 56 degrees, Centigrade, and can therefore be used in the separation of the uranium isotopes by diffusion. In order to get enough material for large-scale separation, a lot of fluorine had to be made fast. It was, and the dividend to industry is a new raw material available at a tenth of its former cost—with the accumulation of wide experience in handling and using it.

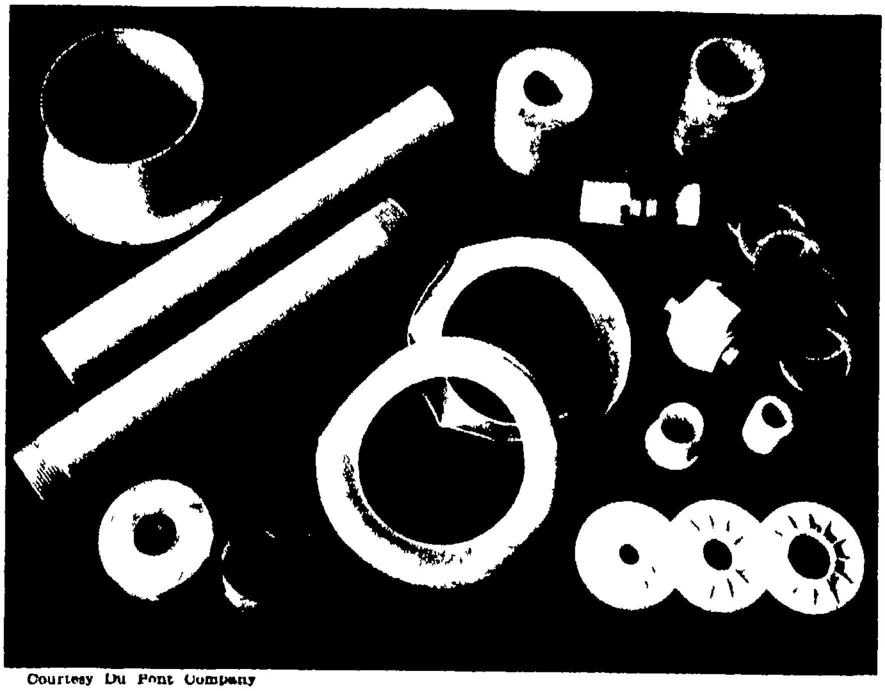
Overhead view (below) of the commercial fluorine cell shows clearly the anode current distributing ring and gas outlet. The cell head, dismantled (right), showed no functional defects after a year's constant service.

Fluorine today is produced by passing an electric current through a melt consisting of potassium fluoride and hydrogen fluoride. The latter material is broken up by the electrical energy into hydrogen and fluorine, which are discharged at the cathode and anode respectively. Because fluorine and hydrogen react explosively, the anode and cathode compartments are separated by a diaphragm to prevent contact of the gases. Additional hydrogen fluoride which is obtained by treating fluorspar with sulfuric acid, is continuously added to replenish the cell. The anodes are of carbon, but the rest of the cell, fortunately, can be

Courtesy Harshaw Chemical Company

Works for Industry

By HOWARD C E JOHNSON, Ph D
Chemical Editor *Chemical Industries*



Courtesy Du Pont Company

Made of Du Pont's 'Teflon" tetrafluoroethylene resin, these articles offer great heat endurance, unusual resistance to solvents, and excellent high frequency insulation

constructed of ordinary carbon steel and Monel These metals, as well as copper and nickel, form a protective surface coating of fluorides upon exposure to the gas, rendering them resistant to further attack

Working out the production of fluorine was difficult, but the problems of handling and storing it were even knottier In several instances fluorine chemistry lifted itself by its own bootstraps The only satisfactory packing material for valves, pumps, gaskets, and the like was a mixture of a metal fluoride and tetrafluoroethylene polymer and the only lubricant for pumps that wasn't attacked by the corrosive gas was a hydrocarbon oil in which all the hydrogen atoms were replaced by fluorine

Remarkable engineering ingenuity is manifest in the design of one of the pumping systems A regular commercial oil-operated diaphragm pump is arranged to transmit pulsations hydraulically to a second diaphragm pumping head in contact with the fluorine The two pumping heads are connected by a pipe passing through a fire wall and containing a highly fluorinated hydrocarbon inert to fluorine The expensive mechanical pump is thus protected in case of failure of the diaphragm or valves in actual contact with the highly corrosive gas

• LOOKING AHEAD •

Large-scale production of fluorine Reduction of cost of the magic gas Compounds of the gas finding new uses in the electrical industry, as refrigerants, and even in textiles

The difficulties of handling and purifying fluorine have been surmounted, and now the gas—over 99 percent pure—can be purchased in steel cylinders containing half a pound at 400 pounds pressure

The possibilities open to industry with fluorine available in convenient form are practically unlimited The substitution of fluorine for hydrogen or chlorine in such things as solvents, polymers, resins, synthetic rubber, and so on, will provide thousands of hours of research and literally thousands of new compounds

HAPPY PARADOX - Even more remarkable than the unequalled chemical activity of elemental fluorine is the stability of some of its compounds It is seemingly a paradox, but it has a valid chemical explanation The fluorine combines with other elements with such energy that once combination is effected, it takes a great deal of energy to break up the combination

Some of the most interesting fluorine compounds, because of their stability, are the so-called fluorocarbons—hydrocarbons in which all the hydrogen is replaced by fluorine Just as hydrocarbons range in properties from gases like methane to waxy solids like paraffin, so do the fluorocarbons consist of a large variety of structures varying in properties from gases through liquids up to solids

These fluorocarbons, unlike the hydrocarbons, will not burn, and indeed, will not react with any of the common chemical reagents They are so stable that, if properly treated fluorine itself will not attack them and, as mentioned above, they can be used in fluorine processing equipment

Their stability to heat, oxidation, and chemical attack nominates them for thousands of potential uses, such as lubrication of heavy-duty bearings where normal oils and greases break down due to high pressures and temperatures, as inert solvents for chemical processes and extractions, and very possibly as heat-transfer agents Protective coatings of fluorocarbons may in the future supplant all existing materials in rust-proofing, protection of paints and varnishes and preservation of wood, and in time may come to be the base of special-duty paints Costly as these materials are at present a large industrial demand would quickly reduce the price to compete with current materials in a great many specialized industrial fields

Fluorine itself reacts too violently with hydrocarbons to give good yields of the corresponding fluorocarbons In the presence of a silver-coated copper wire catalyst, however, the reaction is controllable and gives good yields Another method which is being operated on plant scale employs the use of a metal "carrier" Here a lower fluoride of a metal such as cobaltous fluoride, CoF_2, is treated with fluorine to give the higher fluoride CoF_3 This gives up its extra fluorine to'a hydrocarbon, reverting to CoF_2, whereafter it is regenerated with additional fluorine No fluorine is lost, for the hydrogen fluoride resulting as a by-product from the reaction with the hydrocarbon can be used to regenerate the electrolytic fluorine cell

LONG-LIFE POLYMERS—The first commercial fluorine plastic is a polymer of tetrafluoroethylene—ethylene in which the four hydrogen atoms are replaced by fluorine The gaseous monomer boils at −78 degrees, Centigrade, but the polymer—a translucent, waxy white plastics—is stable up to 250 degrees, Centigrade The chemical resistance of Teflon as the material is called, is outstanding, in that it withstands the attack of all materials except molten alkali metals It can be boiled in aqua regia, hydrofluoric acid or fuming nitric acid with no change in weight or properties It is tough over a wide range of temperatures—from −75 to 250 degrees Centigrade—and its excellent electrical properties point to its use in the power field where one of the limiting features in design of electrical equipment has been the lack of a suitable insulation that will withstand high temperatures

Because of its cost the field for Teflon is limited For uses which can take advantage of its unique properties, however, it is bound to find a market In addition to its use in electrical equipment, it will very likely find applications in the chemical industry as a gasket and packing material and as chemically inert tubing

Other fluorine compounds are also capable of yielding polmeric oils and plastics, but they have not yet advanced beyond the experimental stage Among these are perfluorobutadiene and perfluorovinyl chloride These are just like the familiar butadiene and vinyl chloride except that all the hydrogens are replaced by fluorine In both cases polymerization can be controlled to give oils waxes or hard thermoplastic resins

OTHER COMPOUNDS—The fluorocarbons represent, of course, only a small fraction of organic fluorine compounds Chemists now have ways to introduce fluorine into all types of molecules, multiplying many fold the number of compounds which might improve dyes, plastics, pharmaceuticals synthetic rubbers, insecticides, and a host of other materials

Operating on a laboratory scale, this Harshaw model cell supplies fluorine for reaction in an electric furnace

One of these new compounds, recently introduced, is sodium fluoroacetate, a highly efficient rat poison Others, reported from the laboratory, are octafluoroadipic acid and octafluorohexamethylene diamine The same compounds without fluorine are the basic constituents of nylon Perhaps the next step is a perfluoro nylon!

A very stable gas, sulfur hexafluoride, may have a big future as a refrigerant, a fire extinguishing agent, and as an insulator in high-voltage generators and coaxial cables Its physical properties, its outstanding chemical inertness, and its dielectric properties suggest all three of those fields

FUTURE SCOPE — The industrial possibilities of fluorine chemistry are enormous Fluorine itself can already be produced by the ton, and laboratories are continually finding new ways to use the magic gas and its compounds profitably There is no gainsaying the fact that fluorine and its compounds are still expensive, they are still quoted in dollars per pound rather than cents per pound But the price of fluorine will come down just as surely as the demand will go up, and with the falling price of fluorine will drop the cost of its derivatives Chlorine, made by a very similar process sells for less than two cents per pound and is the basis of a gigantic industry It is safe to predict that fluorine will never be that cheap but it will be cheap enough to become an industrial raw material of importance The day will come—and it is not far off—when fluorine will be playing the big-time circuit

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URANIUM METAL

Suggested as Monetary Standard with True Value

PROPOSED as an international monetary standard to replace the silver and gold that have traditionally set the world's standards of values, uranium's claim to this position is based on the fact that atomic fission can convert a part at least of any mass of uranium directly into energy Energy, the ability to do work, is suggested as a far more logical basis of economic value than any possessed by the precious metals

Several properties of uranium metal preclude its use in actual coins, particularly its hardness and the ease with which it oxidizes The various proposals for international control of fissionable materials as a means to control atomic bombs, however, might lend themselves readily to the issuance of an international currency backed by centrally controlled uranium metal

Under such a scheme, atomic energy could be the basis of a reasonable currency whose value would be keyed to available energy, upon which depends production, the true modern measure of wealth While we may never jingle uranium coins in our pockets, we yet may spend paper currency or coins of more adaptable metals backed by uranium as our present silver certificates are by bars of that metal

ISO-OCTANE SOLVENT

Is One New Use For Reference-Fuel Now Surplus

THE once-rare compound on which the standard anti-knock rating of motor fuels—octane number—is based has now reached such a stage of production that its producers are looking for new uses for it A bare dozen years ago, iso-octane, or chemically 2,2,4-trimethylpentane, could only be had from laborious synthesis of small lots in the laboratory, and its use was confined to the preparation of reference standards for fuel rating This was because of the scarcity and high cost of the hydrocarbon

The aviation fuel program during the war required the production of this compound on a large scale for use in the engines of military planes Production skyrocketed, and now it is suggested that it may prove a valuable solvent in some special cases and that it will lend itself to chemical synthesis

Aluminum Advances On All Fronts

Expanded Production Facilities, Lower Costs, Higher Strengths, and a Wide Range of New and Improved Alloys are Rapidly Opening New Markets Uses Ranging from Door Keys to Railroad Cars Promise to Make Aluminum the Number One Nonferrous Metal of the Future

By FRED P PETERS
Editor in Chief *Materials & Methods*

OF ALL the major metal-producing industries, none was so radically changed in commercial structure and in immediate postwar position by the war as was the aluminum industry The former beneficent monopoly has become a highly competitive field, with the one-time sole producer in a dominant but not controlling position The expansion of production facilities and the accompanying lowered price trend for the metal has placed it in position to become, within the foreseeable future, the Number One nonferrous metal from the standpoint of production and consumption

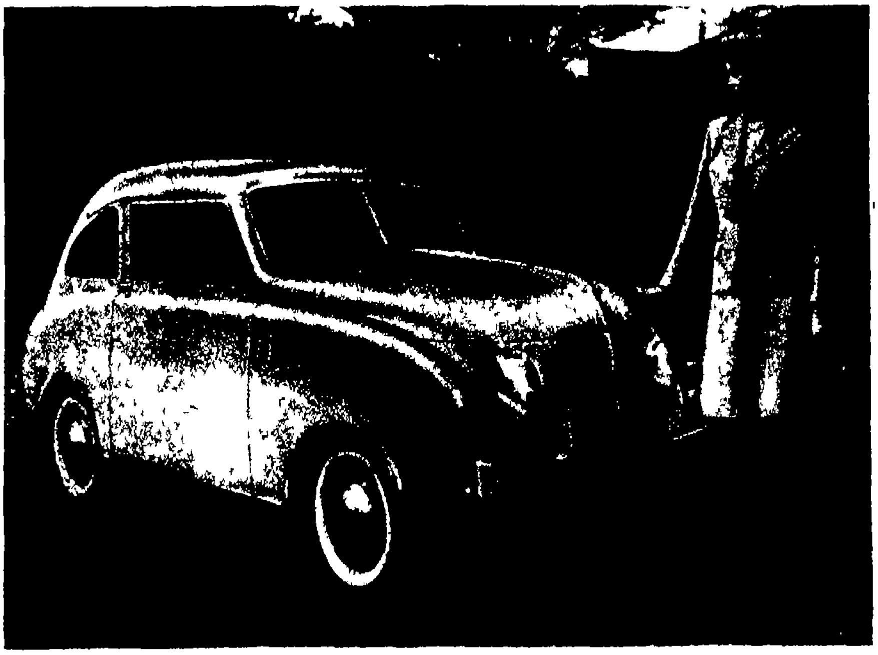
Aluminum is now available in more forms and in a greater number of useful alloys than before the war It has captured markets that were once the province of its heavier competitors and is effectively invading a variety of others The effect of the light metals onslaught on product design is evident everywhere—lawnmowers, ladders, electrical motors, automobile engines furniture, railway cars, trucks buses, high-tension lines, and so on are increasingly made with aluminum or magnesium And aluminum, for the present and for a considerable period in the future at least, will receive the lion's share of applications divided among the light metals

Before the war American production of aluminum amounted to 160,000 tons (1939), virtually all manufactured by Aluminum Company of America During the war to fill the fabulous demands of the airplane production program, aluminum production capacity was expanded many-fold At present, production of aluminum is at the rate of 600,000 tons per year Of today's aluminum reduction capacity, Aluminum Company of America has 52 5 percent, Reynolds Metals Company 30 1 percent, and Kaiser 17 4 percent In addition to the Aluminum Company's long established research, technical service, publications, and market development departments, the industry now also has the analogous divisions of Reynolds working in a similar way to improve its products and expand its markets The obvious and inevitable results of this double-barrelled effort should give rise to some quiet cogitation on the part of producers of other metals

• LOOKING AHEAD •
More designers and manufacturers taking advantage of proved values of aluminum New knowledge of the light metal and its alloys Lighter automobiles and better engine bearings Copper-coated aluminum for electrical parts

ECONOMICS — As pointed out in the article "Coming Changes in Metal-Economics," page 258, December 1946 Scientific American, the gradually falling price of aluminum and the rising price of copper have placed the light metal in a favored position for those applications for which either material is technically suitable This is a fundamental reversal of their earlier positions and should have far-reaching effects on the use of aluminum for electrical conductors of various kinds and for corrosion-resisting and heat-conducting products

While the expanded production facilities for aluminum have had much to do with its improved commercial position, technological advances must also share the credit for this metal's progress Foremost among the latter in recent years have been the new aluminum-base alloys that have been developed for engineering uses New high-strength sheet and extrusion alloys, new clad combinations, new forging alloys, and new engine bearing mate-



Crosley, first post-war automobile with an aluminum body rials have made the lightweight advantages of aluminum even more attractive to engineers by increasing the strengths available in this series of alloys.

Light and sturdy, this aluminum beer barrel provides a shining example of the metal's versatility

Courtesy Reynolds Metals Company

INCREASED STRENGTH—For example, before the war the strongest aluminum alloy available in sheet form was 24S, which in the heat-treated state developed a tensile strength of about 68,000 pounds per square inch. Since then Alcoa has brought out 75S and Reynolds R303. These alloys are basically similar in composition and properties, each consisting of aluminum plus zinc, magnesium, and copper as the principal alloying elements, and each possessing tensile strengths in the heat-treated (that is, the precipitation-hardened) condition in the neighborhood of 82,000 pounds per square inch for sheet and 85,000 for extrusions.

Such tensile strengths are up in the range occupied by the plain carbon structural steels, the aluminum alloys, however, are only about one third as heavy as the steels, so that these new high-strength aluminum alloys have a tremendous advantage over the mild structural steels on a strength-weight basis alone. (Of course, other factors such as cost, weldability, fatigue strength, and so on must also be considered, and these are often favorable to steel. Also, the strength-weight ratios of special steels like stainless are much better than those of plain carbon steel.)

The 75S and R303 alloys have yield strengths that are double those of mild steel, and are not subject to the stress-corrosion cracking that had previously limited the applications of aluminum alloys containing zinc as the chief alloying ingredient. A good example of what the use of these alloys can mean to engineering design is afforded by experience with 75S in the B-29 bombers manufactured in the latter part of the war. Employed in the upper wing skin, for skin sheet and stiffening sections in place of 24S, the new alloy resulted in a saving of about 400 pounds per plane.

No heavier than one of the 175 aluminum ingots stacked on its chassis, the Northrop Gaines aluminum hand truck, which easily bears the load, weighs only 30 pounds

NEW CLADS—Several new types of aluminum-clad aluminum alloy products have recently been introduced to supplement the standard Alclad (or Pureclad) 24S sheet. Special artificial aging treatments for aluminum-clad 24S when combined with cold work, have given tensile strengths in the neighborhood of 70,000 pounds per square inch. Alclad 75S in the heat-treated condition has a tensile strength of 76,000 pounds per square inch and a yield strength of 72,000, both highly respectable figures for an aluminum-clad product. And Reynolds has an aluminum-alloy-clad-with-alloy product for which tensiles up to 75,000 in sheet form and 89,000 as extrusions have been reported.

An innovation has been the use of pure aluminum cladding on lower-strength aluminum alloy materials. For example Alclad 3S sheet (a base of aluminum containing 1.2 percent manganese clad with pure aluminum) possesses outstanding resistance to pitting corrosion, excellent workability and satisfactory mechanical properties for many applications. During the war it was employed for gasoline tanks in airplanes and on PT boats, as well as for water tanks on the latter. It is now being extensively used for such products as mason jar caps and tea kettles.

ALUMINUM-TIN — The development of aluminum-tin alloys for bearing applications has been one of the most promising of recent developments in the aluminum field Alloys containing 6 5 percent tin, some nickel, copper (and, in one alloy, *silicon*), and the remainder aluminum are being studied and experimentally applied for main and connecting rod bearings in several new automobiles

In addition, steel-backed aluminum-tin alloy bearings are receiving increased attention for similar applications The solid bearings have a relatively large number of alloying ingredients to provide individually such desirable bearing properties as fatigue strength and general load-bearing characteristics In the case of the steel-backed bearings the bearing surface is a simple aluminum-tin composition and the required heavy-duty mechanical properties are provided by the steel backing Established uses of aluminum bearings so far have been in the Rolls Royce engine and in Diesels

OTHER ALLOYS — Another new aluminum alloy with a bright future in the architectural and building field is Alcoa's 63S This is a medium-strength non-heat-treating alloy, which is corrosion resistant and takes a beautiful anodized finish without staining or streaking A new aluminum alloy for roofing sheet also has been developed, which is now being increasingly used for farm roofing Not strictly an aluminum-base product, but still one that depends heavily on aluminum for its service characteristics is aluminum-coated steel, now being manufactured by the American Rolling Mill Company As a competitor of painted and galvanized steel and of tinplate and terneplate, aluminum-coated steel may eventually represent a sizeable outlet for aluminum

Advances in processing have also helped to push aluminum forward and to open new applications to it For example, stepped extrusions are now available in aluminum alloys, these are especially useful for such products as aircraft wing spars, which are required to have variable cross sections Larger machines and improved techniques for press forging and impact extrusion have lowered the cost and increased the sizes of aluminum alloy products available in these forms

New casting alloys have also recently entered the aluminum field A General Electric metallurgist has developed an aluminum-base alloy containing copper, beryllium, and cobalt, which has very high strength properties for a casting alloy, high thermal stability, unusual oxidation resistance, and good foundry properties The Aluminum Company of America has brought out its A100 alloy, designed especially for use in rotors of low-resistance electric motors And a new aluminum-magnesium casting alloy, Almag 55, developed by Acme Aluminum Alloys, Inc, has a tensile strength of 50,000 pounds or more, together with good ductility and impact strength, it is described as having the highest combination of tensile and impact strength available in aluminum casting alloys

New materials and methods for brazing aluminum products have expanded the use of aluminum alloys in containers electrical and radio parts, aircraft heat exchangers and refrigeration and air conditioning units Alcoa has developed an Alclad alloy brazing sheet—a composite product which carries on either one or both surfaces a thin layer of low-melting aluminum brazing alloy Special brazing fluxes have also been evolved for use with this new brazing material Reynolds is working on an aluminum sheet flash-coated with copper for easy-to-solder electrical parts (electric light sockets wiring devices and so on) that are now made of brass

APPLICATIONS UNLIMITED —As a result of all this, aluminum and its alloys are being studied for or applied in several significant new fields Aluminum alloys have been shown to be entirely feasible for the superstructure of passenger and cargo ships the lighter weight of the aluminum superstructure brings increased stability, greater load-carrying ability, or greater speed Some marine architects believe that even all-aluminum hulls may be advantageous for certain services

In the automobile field there is intense study of aluminum for both bodies and engines One well-known medium-priced car is now 500 pounds lighter because special attention was given in its design to the use of as much aluminum as possible Readers are undoubtedly familiar with the efficient new Crosley car design and its all-aluminum body Jack and Heintz are using light metals in every possible place in their engines, in the firm belief that everything which moves must be made as light as human ingenuity can devise, and that American industry has an obligation to make the light metals work for them even when the "bugs" may seem more numerous than the benefits

Aluminum is making steady inroads on other materials for use in railway cars of all types Streamlined all-aluminum passenger trains modern lightweight passenger cars, and, most recently, boxcars and hopper cars made largely of aluminum are increasingly seen on the rails The aluminum cars save weight, permit increased payload (or faster runs or less engine power for passenger trains), and are resistant to corrosion from sulfur in coal

Aluminum keys which are only 40 percent of the weight of brass keys and will not wear holes in one's pocket so fast, are already being specified for use with automobiles and should eventually spread to more general use

Indeed, the list of products and industries in which aluminum and its modern alloys are finding new applications is virtually endless As the generally favorable experience of these new users becomes publicized, more and more designers and manufacturers are going to incorporate these light materials in their products The venerable Aluminum Company of America and its younger rivals are in for some busy years—and so are those product manufacturers who make the fullest use of the knowledge and materials made available by all the light metal producers

* * *

DRAWING STAINLESS

Without Tearing or Shearing

A WAR-DEVELOPED process for inexpensively forming tough-to-work sheet metals like stainless steel into deep-drawn and sometimes complicated parts, without tearing or shearing the metal, is now being applied to several peace-time products

Known as the Sol-A-Die process, and developed by engineers of the Solar Aircraft Company, the method is one of "staging" the metal drawing and shaping in such a manner as to reach the final absolute area of the desired form in the first stage —rather than the last—of a series of steps

Up to a recent date the process had been used in producing the stage die patterns for more than 600 parts of some 60 different assemblies having a total value of approximately $25,000,000 The savings reflected in total production costs of assemblies is estimated at from 10 to 15 percent

Beyond the aircraft industry this low-cost staging die process materially aids in reducing tooling charges on low-volume jobs, for example, for custom automobile bodies and experimental designs

PLASTICS on WHEELS

All-Plastics Automobile Bodies are Still Largely in the "Talk" Stage, but New Laminated Plastics Panels are now Being Produced Fast Enough to Keep Up with Operations on One Station-Wagon Assembly Line

By CHARLES A BRESKIN

Editor Modern Plastics

PLASTICS, hardly strangers to the automobile industry, have long been used for interior trim and fittings, for instrument covers, kick plates, jump seats, and for numerous applications in the working parts of cars On a larger scale there has been considerable talk, and some work in the custom field, on all-plastics bodies But the most extensive use thus far made of plastics on an assembly-line basis is to be found in the work of the Briggs Manufacturing Company in paneling the major portion of the inside of an automobile with a plastics laminate

This development makes plastics a material of major importance in the automotive field It goes beyond the idea of mere decoration and places plastics in the class with wood, steel, and other traditional structural materials Today the production of this paneling is geared to the requirements of the DeSoto station wagon assembly line For each car there are turned out four door panels, two rear quarter panels, one rear deck, and two strips to be mounted between the doors This volume, limited thus far to the one model car, is admittedly a small percentage of total automobile production But if this method of processing decorative laminates for car interiors is developed to a point of large mass production, it will carry out the tradition of American mass production—a better product at a lower price with longer wearing qualities and improved appearance

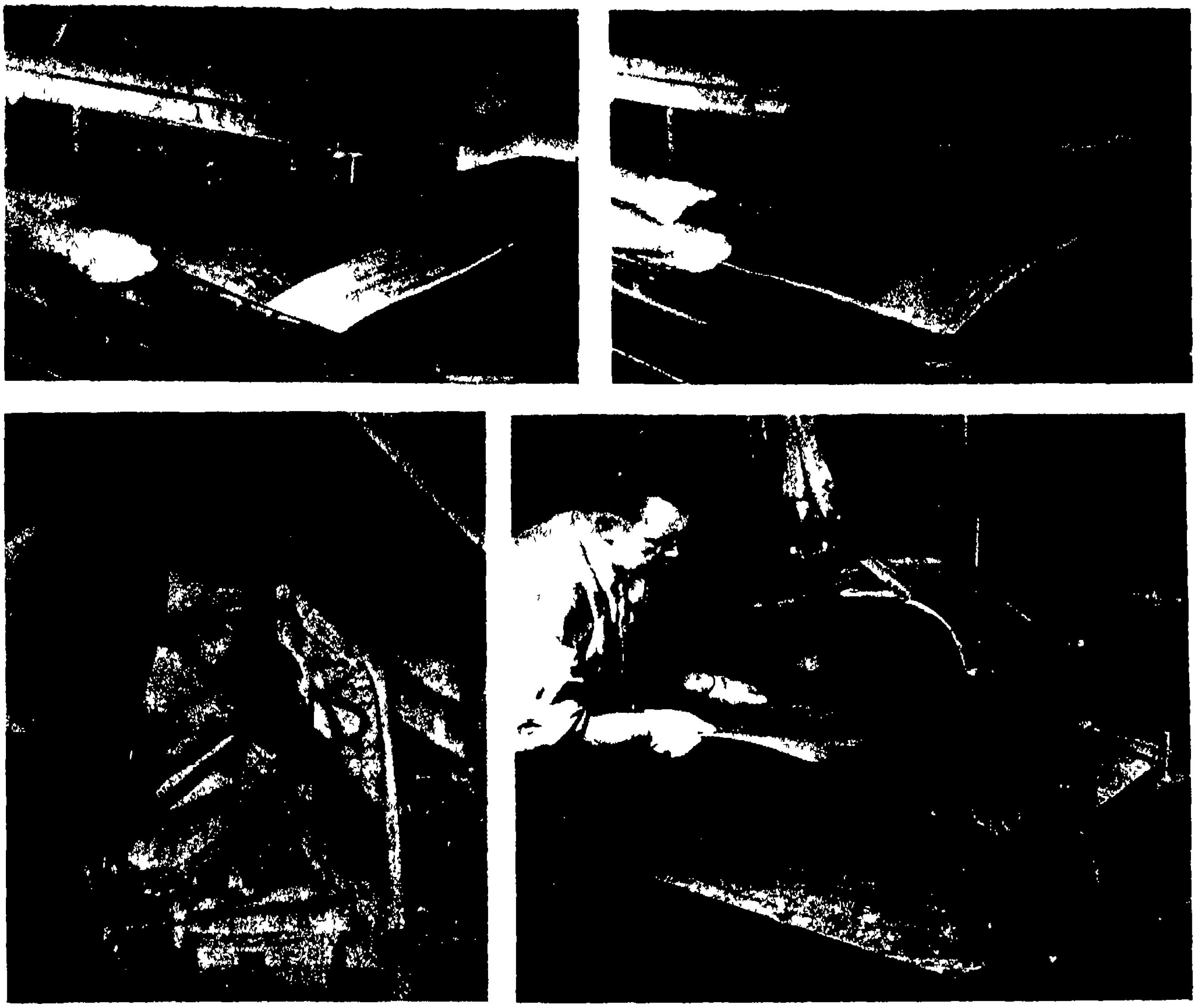
These plastics laminate panels not only are decorative but, tested side by side with traditional materials for wearing qualities, have come through with little if any signs of wear or scratching while the traditional materials showed scuffing and wear and were generally unusable when the test was over Perhaps the best tribute to the resistance of this plastics material lies in the fact that its first application is in a station wagon

For some years, cost of resins and fillers and low speed of production were the principal hinderances to the commercial use of these laminates When Al Prance of the Briggs company took over the development work about four years ago,

First to make such extensive use of plastics, this DeSoto station wagon has interior panels of long lasting wood-grained laminate

With real wood panels as their model, the laminates achieve amazing realism

All illustrations courtesy Briggs Manufacturing Company



Laminates for the door panels ready for die cutting are placed in the press (top, left) where all required holes are pierced and edges trimmed in a single operation (top, right) Rear quarter panels after die cutting are shaped on the forming fixture (bottom, left) and when removed (bottom, right) are ready for the final drilling

• LOOKING AHEAD •

Plastics laminates, resistant to wear and abrasion, competing with conventional structural materials Decorative qualities "built-in" Strong, complex shapes formed on simple wooden molds Better molding of laminates with metal parts inserted

satisfactory panels were being produced experimentally But a lot of work had to be done before production speed could be increased to a point where the processing could keep up with a standard automobile assembly line

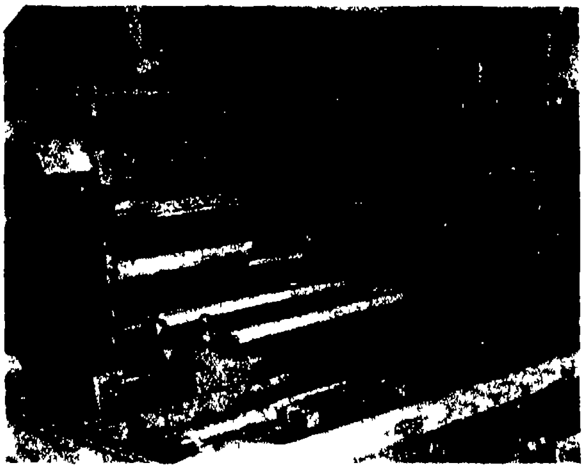
LAMINATE AND PROCESSING — The laminate used in this work comprises high-strength paper laminated to a core of heavy phenolic resin-impregnated alpha cellulose paper The high-strength paper on the exposed face of the laminate is printed with a decorative grain effect, the second skin is of undecorated high-strength paper

There are really two methods presently being used for processing this sandwich structure In fact, one might say that there are two classes of laminates A hot forming method is employed for the parts already described but for the garnish molding on the rear of the front seat of another car—the second and much smaller automotive part being made of the laminate—the process is very similar to that used for molded laminates

Any design in any combination of colors can be reproduced on the decorative sheet used for the exposed surface of the laminate by the use of standard rotogravure methods of printing Since a transparent phenolic resin is used on this outer surfacing, the plastics does not effect the colors as printed In the station wagon the effect is that of wood grain, the authenticity of the graining being assured by the use of actual wood as the copy from which the printing plates are made Variation is achieved by the use of two colors and two grains of paper in the door paneling as contrasted to the single sheet of grained paper in the rear quarter panels, rear deck, and between-the-door strips

FORMING PROCESS — The first step in producing the panels is laying up the resin-impregnated paper sandwich The alpha-cellulose paper for the core is stacked up and sandwiched between the phenolic-resin impregnated high-strength paper that has been cut to the desired shape This positioning of the skins requires some care when sheets with different graining are used in the same assembly

The sandwich is then placed in a laminating press and cured. The cured laminate as taken from the press is held flat by a wooden form until cooled This procedure is necessary because the laminate is



The length of the laminates to be shaped in this mold necessitated the unique hydraulically operated tilting head

After being die cut to size, five sheets of impregnated paper are laid up in the press for molding

unbalanced during cooling and would warp if not held to shape

The die stamping of these laminates, the next step in the process, is very similar to any stamping operation and the speed of the operation is the same For this work the cured and cooled panels are reheated by a bank of infra-red lamps to a temperature of approximately 300 degrees, Fahrenheit The clean cut achieved in this stamping operation practically eliminates further finishing work, also, the holes for mounting the metal trim and the larger hole for the window regulator shaft are completely punched out in one operation The die cutting of the laminates for the rear deck and rear quarter sections is the same as for the flat panels, but these smaller panels remain to be formed

From the die-cutting unit the hot sheets for the deck and rear quarter sections go directly, and while still hot, to a simple forming die Here the laminate is placed on a wooden form which comprises the lower half of the die The upper part of the die is merely a skeleton framework which presses the laminate at certain strategic points to make it conform to the shape of the lower male form The formed panel, after removal from this jig, goes on to another station where assembly holes are drilled

One of the factors that keeps down the cost of these interior panels is the low cost of the wooden dies that are used for shaping Including the cost of the mold material and of the labor involved in the building of the dies, the molds for two left- and two right-hand panels cost about $1000 total If the dies had been made of steel it is estimated that the cost of each die would have been approximately $20,000, making a total die outlay of $80,000 for the four molds

MOLDED LAMINATES - The garnish molding on the rear of the front seat of one make of automobile--a part with more complicated contours than the panels and with molded-in assembly screws—is produced by the second method of processing these laminates Steel molds are used for this work, but they are still not as expensive as metal stamping dies and the completed laminated parts require only simple finishing

The same type of sandwich is used for this garnish molding as for the paneling, but it is used differently Each mold charge of phenolic-resin impregnated paper is die-cut to size and loaded in the mold The brass screws, used for assembly, have large heads and are molded directly into the piece

The set-up of the mold for producing this part raised many problems when this job was undertaken and necessitated the development of unique equipment In a sense this mold resembles somewhat a phonograph record press in that the mold has a tilting top But whereas in the molding of records a tilting head press is used, the mold for the laminated garnish is not fastened to the press at any point and, in operation is withdrawn from the press after each cycle This set-up was made necessary by the length of the garnish molding which is 46 inches Obviously the mechanical requirements for tilting the head of a press big enough for a piece of this size was out of the question

The solution was found in the construction of a tilting head mold—achieved by hinging the top and bottom of the mold at the back—which is retracted from the press and held in the open position by two vertical steel rods operated by hydraulic cylinders

When the curing of a laminated part is complete, the lower platen of the press drops enough to remove the clamping pressure on the mold Two hydraulic rams then move horizontally to push the closed mold out of the press When the mold has come to a stop over two vertical-acting hydraulic plungers these plungers move upward and open the mold The mold tilts open enough to give ample clearance between the two halves for the removal of the molded parts and the reloading of the mold with a new charge The layup complete, the vertical plungers retract, lowering the upper portion of the mold until it is in contact with the new charge The horizontal plungers then move the mold back into the press and the molding operation is repeated

Movements of the mold and press, as well as the timing of the molding cycle are all push-button controlled, even preheating of the material is automatic and the infra-red lamps for heating the panels are in an automatic time-switch circuit

At the time of writing, all the operations on the inside station wagon paneling and on the garnish molding are being carried out in the plastics laboratory of the Briggs plant The operations, however, are not at all in the laboratory class but are set up on a production basis Equipment similar to that now in operation is being installed in one of the company's large production sections and, very shortly, these automotive parts will be produced at this new location

PILOTS
to
PROFITS

Reducing the Time Gap Between Conception and Production, Pilot Plants Can Also be Profitable in Themselves Flexibility of Pilot Plant Equipment Permits It to be Equally Valuable Whether Used in the Plant Laboratory or on the Active Production Line Co-Operative Pilot-Plant Operation is Being Adopted by Many Industries Today

By EDWIN LAIRD CADY

Courtesy Lincoln Electric Company

Many forms of welding have become successful because of previous work and study conducted in pilot plants

THERE was a time when the Hodgman Rubber Company could not take an order for anything but its few standard lines of rubber coated sheetings Come good times or bad, plant speed-ups or plant shut-downs big profits or cut-throat competition, the factory had to run on those few items or else make nothing A number of competitors made the same goods and were hungry for the same orders Lush years were few

Pilot-plant operation changed all that and is doing the same job for hundreds of other manufacturers Now Hodgman can take orders for hundreds of different specialties switch its production to the lines in greatest demand, enter dozens of new fields, pioneer

• LOOKING AHEAD •

Quicker change-over of production to meet—or avoid—competition

Better understanding of economics of factory equipment operation

Broader diversification of machinery and product applications

There was plenty of justice for the older attitude Hodgman uses heavy slow moving machinery Raw materials in powdered and plastic forms are fed and re-fed to huge rolling machines which patiently spend hours mixing and compounding a single batch Colors are mixed in large tanks and again must be stirred for hours, the changing of a color which is being mixed in a tank requires that the whole tank be taken apart, its ponderous paddles lifted out by a chain hoist, and the tank barrel laid on its side so it can be scraped by hand Almost no working mechanism turns at over 500 revolutions per minute, and 20 is more common Changing a product meant experimenting with all of this machinery until the new line was running just right The adjustments could take weeks of trial and error

ERROR REDUCED — Under the present set up there is almost no trial and error at the big machines The specifications of a new product are sent directly to the plant laboratory Here the production procedures are worked out, by the use of test tubes and hand mixing apparatus if necessary

In the laboratory are all the standard and special testing instruments that can be used for this line The testing procedures to use these for complete control of the production line are worked out also

Now the development is ready for the pilot plant Part of this is in the laboratory, other parts are in the main factory where they can be used for production lines when the laboratory does not need them

The pilot-plant equipment in a factory of this kind is smaller in size and capacity than most of the main production equipment But it is highly flexible It can be used for minor variations of the main products and thus can permit the manufacture of small lots of highly profitable special products

Once the pilot plant has shown just how to make and test or inspect a new item the main production equipment supervisors can go ahead They have clear instruction sheets Very seldom do they have to make any major changes in procedures And in the meantime almost all of the small lots made on a test and development basis in the pilot plant are saleable goods The pilot plant very often runs on the basis of making profits in its own right And the pilot plant has provided such flexibility of operations, such ease of changing from product to product that almost never will this company have to produce goods on which it must meet cut-throat competition

SCREW MACHINES — One of the major manufacturers of automatic screw machines started a pilot plant equipped with its own machines and those of its competitors just to see how all of them would perform For years this plant has grown until now it is one of the largest screw-machine products contract factories in existence Basic reason for this growth is the fact that this pilot plant has produced many new developments in screw-machine products and has created much new business for all contractors

One new development is the machining of cast bars of special alloy steels These bars can be made by precision investment casting, but only in lengths up to about 18

Courtesy Hodgman Rubber Company

Started in the laboratory (above), pilot plant operations can keep trial and error troubles from huge machines

inches—much too short for fabricating in ordinary automatic screw machines

The screw-machine maker has spent thousands of dollars and months of time developing butt-welding techniques so these cast bars can be joined into the long lengths profitable for screw-machine operation Once this technique is ready (and it is nearly ready now), then an important gap between the techniques of precision investment casting all the contours of an alloy piece and of machining part or all of those contours out of solid bar stock will have been bridged Makers of all varieties of automatic screw machines, and of lathes and other machine tools, will benefit Precision investment casters will lose some business which they have taken from the automatic screw-machine contractors, but will gain a great deal of tonnage of partly formed or modified bar stock business which will come from those contractors The alloy steel picture will be improved Hundreds of brand new products will be created

LESS SCRAP—Another costly problem will be reduced for the contractors Right now their machines can work only to the last few inches of bars, especially when the machining operations are severe and require the machine chucks to have plenty of bar stock area for gripping The bar "ends" which are too short to grip have to be pushed out of the chucks so new bars may be inserted Those ends are high-cost scrap Getting them down to the shortest possible lengths requires expensive tooling, chucking, and setting up of machines

This new butt-welding technique will permit bar to be so welded to bar that in many cases there will not be any "ends" By following the welding process with a heat treatment which sometimes can be performed by induction heating or by gas flames while the stock is in the automatic screw machine, the welded area may be made so much like the rest of the bar stock that it can be machined into finished products and there will be no waste other than a little flash caused by the welding process

Such a saving of high-cost alloy steel and of machine time could be developed only in a pilot plant that is paying profits out of which development costs can be met And

(*Please turn to page* 75)

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BORING MACHINE — HORIZONTAL, PRECISION BRIDGE TYPE, SINGLE END

(WAA S. C Code 3411-31)

Manufacturer: EX-CELL-O CORPORATION DETROIT MICH

MODEL	SIZE AND CAPACITY	SALES PRICE
2112-A Single End	6" diameter bore, x 12" table travel	$ 720 00
2112 A Single End	6" diameter bore, x 18" table travel	655 00
112-C Single End	8" diameter bore, x 16" table travel	1036.00
112-C Single End	6" diameter bore, x 20" table travel	1139.00

Manufacturer: THE HEALD MACHINE COMPANY, WORCESTER MASS

MODEL	SIZE AND CAPACITY	SALES PRICE
49 Bore Matic, Standard, Single End	12" diameter bore, x 18" table travel	$ 1993 00
49-B Bore Matic, Standard, Single End	9" diameter bore, x 14" table travel	1451 00
47 A Bore-Matic, Standard, Single End	9" diameter bore, x 13 3/8" table travel	1178 00
47 A Bore Matic, Special Single End	9" diameter bore, x 15" table travel	1186 00
48 Bore Matic, Single End	6" diameter bore, x 9" table travel	714.00
48 A Bore Matic, Single End	6" diameter bore, x 12" table travel	714 00
49 Bore Matic, Standard Single End	6" diameter bore, x 12" table travel	1116 00

Manufacturer: STOKERUNIT CORPORATION MILWAUKEE, WIS

MODEL	SIZE AND CAPACITY	SALES PRICE
Mod. 1 Horizontal Single End	4" diameter bore, x 9" table travel	354 00
Mod. 2 B Horizontal, Single End	8" diameter bore, x 15" table travel	444 00

DRILL PRESS — FLOOR TYPE SINGLE OR MULTIPLE SPINDLE

(EXCEPT 110 VOLT SINGLE PHASE)

(WAA S. C. Code 3413-21)

Manufacturer: ALLEN—CHARLES C. ALLEN CO BARRE, MASS

MODEL	SIZE AND CAPACITY	SALES PRICE
HMD — Super Speed (Floor)	5/16" drill capacity 16" swing 3 spindle	$ 511 00
HMD — Super Speed (Floor)	5/16" drill capacity 16" swing, 4 spindle	657 00
HMD — Super Speed (Floor)	5/16" drill capacity 16" swing 6 spindle	$ 948 00
HMD — Super Speed (Floor)	5/16" drill capacity 24" swing 1 spindle	229 00
HMD Super Speed (Floor)	5/16" drill capacity 24" swing 2 spindle	382 00
HMD — Super Speed (Floor)	5/16" drill capacity 24" swing 3 spindle	535 00
2 KH (Floor)	5/8" drill capacity 14" swing 1 spindle	$ 177 00
2 KH (Floor)	5/8" drill capacity 14" swing 2 spindle	279 00
2 KH (Floor)	5/8" drill capacity 14" swing, 3 spindle	381 00
2 KH (Floor)	5/8" drill capacity 14" swing, 4 spindle	483 00
2 KH (Floor)	5/8" drill capacity 14" swing 6 spindle	687 00
2 KH (Floor)	5/8" drill capacity 24" swing, 1 spindle	$ 185 00
2 KH (Floor)	5/8" drill capacity 24" swing, 2 spindle	295 00
2 KH (Floor)	5/8" drill capacity 24 swing, 3 spindle	394 00
2 KH (Floor)	5/8" drill capacity 24" swing 4 spindle	513 00
2 KH (Floor)	5/8" drill capacity 24 swing, 6 spindle	732 00
2 MSV (Floor)	7/8" drill capacity 16" swing, 1 spindle	$ 240 00
2 MS (Floor)	7/8" drill capacity 16 swing, 2 spindle	449 00
2 MS (Floor)	7/8" drill capacity 24" swing 2 spindle	469 00
2 MS (Floor)	7/8" drill capacity 24" swing, 4 spindle	910 00
2 MS (Floor)	7/8" drill capacity 30" swing, 3 spindle	718 00
2 V Belted (Floor)	7/8" drill capacity 16" swing, 1 spindle	$ 184 00
2 V Belted (Floor)	7/8" drill capacity 18" swing, 2 spindle	266 00
2 V Belted (Floor)	7/8" drill capacity 16 swing 4 spindle	440 00
2 V Belted (Floor)	7/8" drill capacity 24" swing 3 spindle	382 00
2 V Belted (Floor)	7/8" drill capacity 30 swing, 1 spindle	196 00
2 1/2 MSV (Floor)	1 1/8" drill capacity 16" swing, 2 spindle	$ 449.00
2 1/2 MSV (Floor)	1 1/8" drill capacity 16" swing, 4 spindle	810 00
2 1/2 MSV (Floor)	1 1/8" drill capacity 16" swing, 6 spindle	1171 00
2 1/2 MSV (Floor)	1 1/8" drill capacity 24" swing, 1 spindle	281 00
2 1/2 MSV (Floor)	1 1/8" drill capacity 24" swing, 2 spindle	469 00
2 1/2 MSV (Floor)	1 1/8" drill capacity 24" swing, 4 spindle	845 00
2 1/2 MSV (Floor)	1 1/8" drill capacity 24" swing, 6 spindle	1033 00
3-V Belted (Floor)	1 1/4" drill capacity 24" swing, 1 spindle	268 00
3-V Belted (Floor)	1 1/4" drill capacity 24" swing, 2 spindle	449 00
3 V Belted (Floor)	1 1/4" drill capacity 24" swing, 3 spindle	632 00

Manufacturer: AVEY DRILLING MACHINE CO , CINCINNATI, OHIO

MODEL	SIZE AND CAPACITY	SALES PRICE
1 MA-6 Floor Box Column	1/2" drill capacity 15" swing, 1 spindle	$ 175 00
2 MA 6 Floor Box Column	7/8" drill capacity 15" swing, 1 spindle	243 00
2 MA-6 Floor Box Column	7/8" drill capacity 15" swing, 2 spindle	$ 448 00
2 MA-6 Floor Box Column	7/8" drill capacity 15" swing, 3 spindle	652 00
2 MA-6 Floor Box Column	7/8" drill capacity 15" swing, 4 spindle	856 00
2 MA-6 Floor Box Column	7/8" drill capacity 24" swing, 4 spindle	710 00
2 MA-6 Floor Box Column	7/8" drill capacity 24" swing, 5 spindle	877 00
2 MA-6 Floor Box Column	7/8" drill capacity 24" swing, 6 spindle	$ 1044 00
2 MA-6 Floor Box Column	7/8" drill capacity 30" swing, 3 spindle	729 00
No. 3 Belted, Floor Box Column	1" drill capacity 24" swing, 1 spindle	249 00
3 MA-6 Floor Box Column	1 1/8" drill capacity 24" swing, 6 spindle	2122 00
3 MA-6 Floor Box Column	1 1/4" drill capacity 24" swing, 1 spindle	390 00
3 MA 6 Floor Box Column	1 1/4" drill capacity 24" swing, 3 spindle	$ 1083 00
3 MA-6 Floor Box Column	1 1/4" drill capacity 24" swing, 6 spindle	2122 00
3 BMA 1 Floor Box Column	1 1/4" drill capacity 24" swing, 1 spindle	279 00
3-BMA 1 Floor Box Column	1 1/4 drill capacity 24" swing, 3 spindle	754 00
No. 3 Standard Floor Box Column	1 1/4" drill capacity 24" swing, 3 spindle	614 00
No. 3 Standard Floor Box Column	1 1/4" drill capacity 24" swing, 4 spindle	791 00

Manufacturer: BUFFALO FORGE COMPANY BUFFALO N Y

MODEL	SIZE AND CAPACITY	SALES PRICE
Model 14 Pedestal, Box Column, "High Speed	1/2 drill capacity 14 swing 1 spindle	$ 120 00
Model 2 Floor Box Column Motor Spindle	7/8" drill capacity 16" swing 1 spindle	243 00
Model 2 Floor Box Column "Motor Spindle	7/8" drill capacity 20" swing, 1 spindle	266 00

Manufacturer: CANEDY OTTO MFG CO CHICAGO HEIGHTS, ILL

MODEL	SIZE AND CAPACITY	SALES PRICE
No. 5000 FV Floor Box Column	3/8" drill capacity 16" swing 1 spindle	$ 172 00

Manufacturer: EDLUND MACHINERY CO , INC , CORTLAND, N Y

MODEL	SIZE AND CAPACITY	SALES PRICE
1 B 7" Floor Type	3/8" drill capacity 14 swing, 1 spindle	$ 140 00
1 B 7" Floor Type	3/8" drill capacity 14 swing, 2 spindle	239 00
1 B 7" Floor Type	3/8" drill capacity 14" swing, 3 spindle	330 00
1 B 7" Floor Type	3/8" drill capacity 14" swing 4 spindle	391 00
1-B 7" Floor Type	3/8" drill capacity 14" swing 6 spindle	604 00
1 B 12" Floor Type	3/8" drill capacity 24" swing, 1 spindle	$ 152 00
1-B 12" Floor Type	3/8" drill capacity 24" swing 3 spindle	348 00
1 B 12" Floor Type	3/8" drill capacity 24" swing, 4 spindle	411 00
2 B 8" Floor Type	3/4" drill capacity 16" swing 1 spindle	195 00
2 B 8" Floor Type	3/4" drill capacity 16" swing, 2 spindle	356 00
2 B 8" Floor Type	3/4" drill capacity 16" swing, 3 spindle	$ 524 00
2 B 8" Floor Type	3/4" drill capacity 16" swing, 4 spindle	691 00
2 B 8" Floor Type	3/4" drill capacity 16" swing 6 spindle	1025 00
3 B 12" Floor Type	3/4 drill capacity 24" swing 1 spindle	208 00
3 B 12" Floor Type	3/4" drill capacity 24" swing 2 spindle	378 00
3 B 12" Floor Type	3/4" drill capacity 24" swing, 3 spindle	$ 588 00
3 B 12" Floor Type	3/4" drill capacity 24" swing 4 spindle	775 00
3 B 12" Floor Type	3/4" drill capacity 24" swing, 6 spindle	1019 00
2 MS 12" Floor Type	3/4" drill capacity 30" swing, 2 spindle	468 00
4 B 12" Floor Type	1" drill capacity 24" swing, 1 spindle	293 00

just look at these typical

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Gear Cutting Machine for Straight Bevel Gears (Not Planer Type)
Gear Hobber —Horizontal
Gear Hobber—Vertical Universal
Gear Shaper - For External Spur Gears Only
Gear Shaper— For Spur Gears, External or Internal
Gear Shaper— For Spur and Helical Gears External and Internal
Gear Tooth Shaver—For External and Internal Gears (Rotary Type Machine)
Gear Tooth Grinder—Generating Type for Spur and Helical Gears
Gear Tooth Grinder— For Spur Gears External and Internal (Formed Wheel Type Machine)
Grinders—Centerless
Grinder—Crank Pin Grinders
Grinders Plain External Cylindrical Grinder
Grinder Internal Cylindrical Automatic Sizing
Grinder Internal Cylindrical (Hydraulic Feed Machine)
Grinder Internal Cylindrical Hydraulic Feed for Hole and Face Grinding
Grinder Surface Rotary Table Type
Lathe—Multiple Tool Not Automatic Manufacturing Type Production Lathe
Milling Machine—Automatic and Manufacturing Knee Type
Milling Machine—Plain Bed Type Horizontal Spindle Machines
Milling Machine—Vertical Knee Type (Not Including Bench Type)
Polishing and Buffing Machine—Bench and Floor
Profiling Machine—Vertical Fixed Bed Type Single and Multiple Spindle
Tapping Machine—Vertical Single or Multiple Spindle
Thread Grinding Machines
Thread Milling Machine
Turret Lathe - Ram Type Plain and Universal

ALL TOOLS SUBJECT TO PRIOR SALE

Manufacturer: FOOTE-BURT COMPANY, CLEVELAND, OHIO		
Mod. DE 1 Floor, Box Column	3/16" drill capacity 14" swing, 1 spindle	$ 127 00
Mod. 2 Floor Box Column	7/8" drill capacity 16" swing, 1 spindle	147.00
Mod. 2 Floor Box Column	7/8" drill capacity 16" swing, 2 spindle	255 00
Mod. 2 Floor Box Column	7/8" drill capacity 16" swing, 6 spindle	$ 706.00
Mod. 2 Floor, Box Column	7/8" drill capacity 24" swing, 1 spindle	156 00
Mod. 2 Floor, Box Column	7/8" drill capacity 24" swing, 2 spindle	274 00
Mod. 2 Floor Box Column	7/8" drill capacity 24" swing, 3 spindle	$ 391 00
Mod. 2 Floor Box Column	7/8" drill capacity 24" swing, 4 spindle	510 00
Mod. 2 Floor Box Column	7/8" drill capacity 24" swing, 6 spindle	745 00
Mod. 3 Floor Box Column	1 1/4" drill capacity 24" swing, 1 spindle	$ 279 00
Manufacturer: THE FOSDICK MACHINE TOOL CO CINCINNATI OHIO		
No. 4 Floor Box Column	7/8" drill capacity 24" swing, 1 spindle	$ 255 00
No. 4 Floor Box Column	7/8" drill capacity 24" swing, 3 spindle	601 00
No. 4 Floor, Box Column	7/8" drill capacity 24" swing, 4 spindle	793 00
No. 4 B. M Floor Box Column	1" drill capacity 16" swing, 1 spindle	$ 293 00
No. 4 B. M Floor Box Column	1" drill capacity 16" swing, 2 spindle	293.00
No. 4 B M. Floor Box Column	1" drill capacity 24" swing, 1 spindle	307 00
No. 4 B. M Floor, Box Column	1" drill capacity 24" swing, 4 spindle	1009 00
No. 5 B M Floor Box Column	1 1/2" drill capacity 24" swing, 1 spindle	$ 722 00
No. 5 B. M Floor Box Column	1 1/2" drill capacity 24" swing, 2 spindle	790 00
No. 5 B. M. Floor Box Column	1 1/2" drill capacity 24" swing, 6 spindle	2219 00

IMMEDIATE DELIVERY b

25%

Manufacturer: LELAND GIFFORD COMPANY, WORCESTER MASS		
No. 1 LMS Floor Motor Spindle	3/8" drill capacity 12" swing, 1 spindle	$ 156 00
No. 1 LMS Floor Motor Spindle	3/8" drill capacity 12" swing, 2 spindle	274 00
No. 1 LMS Floor Motor Spindle	3/8" drill capacity 12" swing, 3 spindle	414 00
No. 1 LMS Bench, Motor Spindle	3/8" drill capacity 20 swing, 1 spindle	147 00
No. 1 LMS Bench, Motor Spindle	3/8" drill capacity 20" swing, 4 spindle	527 00
No. 1 LMS Floor Motor Spindle	3/8" drill capacity 20" swing, 1 spindle	168 00
No. 1 LMS Floor Motor Spindle	3/8" drill capacity 20" swing, 2 spindle	$ 308 00
No. 1 LMS Floor Motor Spindle	3/8" drill capacity 20" swing, 3 spindle	449 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 14" swing, 1 spindle	275 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 14" swing, 2 spindle	475 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 14" swing 3 spindle	691 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 14" swing, 4 spindle	$ 907 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 14" swing, 5 spindle	1109 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 14" swing 6 spindle	1312 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 20" swing, 1 spindle	285 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 20" swing, 2 spindle	491 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 20" swing, 3 spindle	$ 714 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 20" swing, 4 spindle	935 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 20" swing, 6 spindle	1349 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 26" swing, 1 spindle	297 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 26" swing, 2 spindle	514 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 26" swing, 3 spindle	$ 751 00
No 2 LMS Floor Motor Spindle	7/8" drill capacity 26" swing, 4 spindle	984 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 26" swing, 5 spindle	1206 00
No. 2 LMS Floor Motor Spindle	7/8" drill capacity 26" swing, 6 spindle	1426 00
No. 3 MS Floor Motor Spindle	1" drill capacity 24" swing, 1 spindle	$ 427 00
No. 3 MS Floor Motor Spindle	1" drill capacity 24" swing, 2 spindle	780 00
No. 3 MS Floor Motor Spindle	1" drill capacity 24" swing, 3 spindle	1154 00
Manufacturer: THE TAYLOR AND FENN COMPANY, HARTFORD CONN		
Mod. B Floor Box Column	3/8" drill capacity 16" swing, 6 spindle	$ 477 00
Manufacturer: THE TOLEDO GENERAL MFG CO TOLEDO OHIO		
Model KTV Floor Box Column	7/8" drill capacity 24" swing, 4 spindle	$ 185 00

GRINDER — INTERNAL CYLINDRICAL, (HYDRAULIC FEED MACHINE)

(WAA S. C. Code 3415-23)

MODEL AND DESCRIPTION	SIZE AND CAPACITY	SALES PRICE
Manufacturer: BRYANT CHUCKING GRINDER CO , SPRINGFIELD, VT		
Model 16 16 Internal Grinder Hydraulic Feed	16" swing x 13" stroke	$1475 00
Model 16-22 Internal Grinder Hydraulic Feed	22" swing x 13" stroke	1668 00
Model 16C 16 Internal Grinder Hydraulic Feed	16" swing x 13" stroke	1647.00
Model 16F 20 Internal Grinder Hydraulic Feed	20" swing x 13" stroke	$1766.00
Model 24 20 Internal Grinder Hydraulic Feed	20" swing x 16" stroke	2051.00
Model 24 30 Internal Grinder Hydraulic Feed	30" swing x 16" stroke	2427.00
Model 24L 20 Internal Grinder Hydraulic Feed	20" swing x 24" stroke	$2589.00
Model 112M Internal Grinder Hydraulic Feed	16" swing x 8" stroke	2292.00
Model 16-30 Internal Grinder Gap Bed	30" swing x 8" stroke	1800.00
Manufacturer: THE HEALD MACHINE COMPANY, WORCESTER, MASS.		
Model 81 Plain Chucker, Internal Grinder Hydraulic Feed	8" swing x 3" stroke	$1122 00
Model 72 A 3 Plain Chucker Internal Grinder Hydraulic Feed	11 1/2" swing x 12" stroke	1327 00
Model 72 A 5 Plain Chucker Internal Grinder Hydraulic Feed	11 1/2" swing x 20-5/8" str	1415 00
Model 74 Plain Chucker Internal Grinder Hydraulic Feed	24" swing x 18" stroke	$1940 00
Model 172, Gap, Plain, Internal Grinder Hydraulic Feed	30" swing x 13" stroke	1778 00

PROFILING MACHINE — VERTICAL, FIXED BED TYPE, SINGLE AND MULTIPLE SPINDLE

(WAA S. C. Code 3417-63)

MODEL AND DESCRIPTION	SIZE	SALES PRICE
Manufacturer: THE FREW MACHINE COMPANY, PHILADELPHIA, PA		
No 6 A Single Spindle	24" x 36" table size	$ 793.00
Manufacturer: MOREY MACHINERY COMPANY, INC., NEW YORK, N Y		
No 12 M Single Spindle	23" table travel	$ 705.00
No 12 M Two Spindle	23" table travel	742.00
Manufacturer: PRATT AND WHITNEY DIVISION, HARTFORD, CONN.		
No M 1083 Single Spindle, No. 12 B	20" table travel	$ 731 00
No M 1083 Two Spindle, No. 12 B	20" table travel	844 00
No. M 1482 Single Spindle	32" table travel	1678 00

GEAR TOOTH GRINDER — GENERATING TYPE, FOR SPUR AND HELICAL GEARS

(WAA S C. Code 3414 71)

MODEL AND DESCRIPTION	SIZE AND CAPACITY	SALES PRICE
Manufacturer: THE FELLOWS GEAR SHAPER CO SPRINGFIELD, VT		
No. 12 Spur and Helical, External only	12" pitch diameter x 1 1/2" face width	$ 1117 00
Manufacturer: PRATT AND WHITNEY DIVISION, HARTFORD CONN		
M 1635 Spur	10 1/4" pitch diameter x 6" face width	$ 1791 00
M 1639 Helical	10 11/16" pitch diameter x 6" face width	2528 00
M 1679 Helical, Two Wheel	10 11/16" pitch diameter x 1 1/4" face width	3300 00
M 1638 Helical	18 1/2" pitch diameter x 6" face width	4292.00

GOVERNMENT WAA SURPLUS

Sales to priority claimants which include Federal Agencies Certified Veterans World War II, and subsequent priority claimants will be made in proper sequence as required by law

Exporters Your business is solicited if sales are conducted at various levels you will be considered as a wholesaler Any inquiries regarding export control should be referred to Office of International Trade Department of Commerce Washington D C

. . . and no priorities needed

To make purchases visit any of the W A.A. offices listed below; your regular machine tool dealer, or any W.A.A. Machine Tool Site Sale advertised in your local paper You can arrange on the spot for immediate purchase Remember, however, that the particular machine you want may be located elsewhere and shipping times these days are still uncertain But you will *not* have to wait for lengthy clearances of priorities on nation-wide search of stocks. The machines *are* available for immediate sale

W.A.A. announced last month its Important New Price Policy on 31 types of General Production Tools.

But just as a reminder here is how W A A.'s new price has been set for a typical machine, Model 2K Kearney and Trecker Milling Machine, vertical knee type; W A A S C Code 3417 23 20 28

Price (New)	$7,054.00
Previous W A A Sales Price (Based on depreciation primarily)	4,091 00
Average Market Value	2 556 00
New W A A Sales Price	2,045 00
Available for rebuilding	511 00

GOVERNMENT SURPLUS
WAA

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(starred offices have the longest and most complete inventories of surplus machine tools—but stocks are extensive in *all* offices Watch your newspaper for special machine tool sales in your area)

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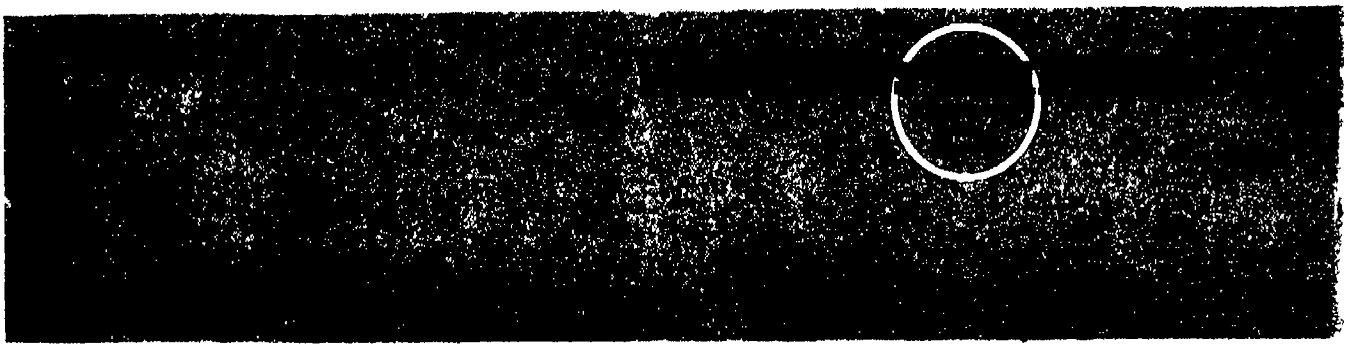
MACHINE TOOL
SALES DIVISION

686-2



(*Continued from page* 70)

this same plant is working out new tooling methods, experimenting with cutting oils and with tool materials and designs, finding ways to machine steels that have been hardened by heat treating, solving plenty of other problems for the entire industry.

CO-OPERATIVE PILOTS—A maker of special oils, fiber products, and chemicals uses the pilot plants of nearby customers. This arrangement is good for both sides. It gives the maker the independent opinions of pilot-plant technical men outside of his own shop. And it gives the owners of those plants the first chances to benefit by the latest developments.

When the technical staff has a new idea the first steps are taken in the plant laboratory. Likewise, when a customer shows that he has need for an oil or other product which cannot be found in the open market the laboratory begins to look into its resources. Company sales engineers bring in ideas also. The laboratory, then receives hundreds of ideas and requests; they come from automobile makers, rayon plants, steel heat treaters, cement mills, and every corner of industry.

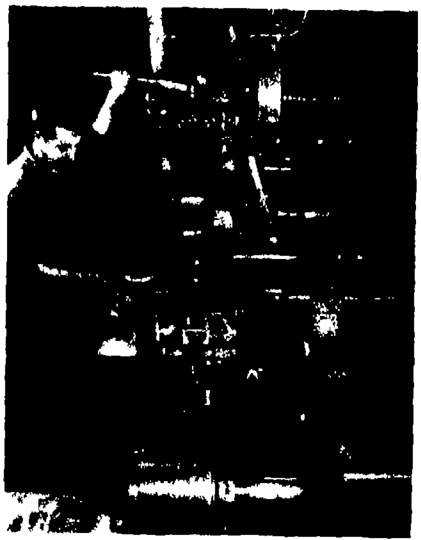
Out of these possibilities there always are a few which can be worked out immediately, and a much larger number which must either be discarded or else planned for slow development. Some experiments will be "luckier" than others with the result that the solutions of some problems are found sooner than others.

As fast as such a solution gets out of the laboratory stage it must go to a pilot plant for further study. The laboratory erects such pilot facilities as it can, but it is obvious that miniature steel mills, silk mills, paper mills, screw machine products plants, and so on can hardly be kept going side by side under the same roof.

The pilot plants of customer companies are asked to co-operate. But here another problem is found. Each pilot plant is set up to serve the production methods peculiar to its own factory. It is not designed for the broad purpose of studying the entirely different methods of competing factories.

A new product may be applicable to like problems in highly diversified industries. For example, a lubricant designed to operate at high temperatures while transmitting electric currents would find use in seam welding shops as well as in many an automatic instrument controlled chemicals industry—and the requirements of these two would be very little alike. Therefore the pilot-plant tests have to be broadened. Fortunately, the pilot-plant engineers get fun out of thinking about problems in industries other than their own, and often make discoveries profitable to their own factories in that way.

The pilot plants may show that the products need to go back to the laboratories for further study. They at least show what the product limitations are, and what techniques and methods must be changed when the products are applied to production lines. And, in the end, new and widely useful products are obtained.



Courtesy Belden Manufacturing Company

A pilot plant first showed the best way to do this wire forming operation

This co-operative use of pilot plants has been fifty years in the development. It is being adopted by many companies. In the steel industry alone it recently has given the world the electropolishing process, the flame cutting of stainless steel, and the sodium hydride descaling process.

IN WELDING—Pilot-plant operations at the Lincoln Electric Company are based largely on the idea that arc welding success usually depends upon what one man can do with one electrode.

Such an operation as the arc welding of assemblies of laminations for electrical use without doing anything which will short circuit the laminations, for example, is developed in this way. The operation is engineered first, of course. But once off the drawing board the equipment is erected in an isolated part of the production floor and a highly skilled welding operator is told to run it. Slowly and carefully he develops his methods, talking them over with his supervisors and getting their suggestions as he goes, but making a great many of his own experiments.

When he has the job running at a satisfactory production rate his methods are studied and reduced to production standards. Lincoln then is ready for another announcement to the trade, another statement that a welding problem has been solved in such a way that any good weldery can apply the techniques and go out and get business for itself.

Pilot-plant operations are as infinitely varied as is industry itself. One thing they have in common. Wherever they are found they are developing in months products and techniques which formerly would have been years in the study.

• • •

ABRASIVE BLASTERS

Separate Worn Grit By Washing-Out Process

DUSTS will stratify in air. If the dusts are confined then their stratification can be controlled and some strata can be washed out while the desired ones are allowed to remain.

One use of this principle is for abrasive blasting machines which remove the spent and broken abrasive particles from the undamaged grains and permit the reuse of the good ones.

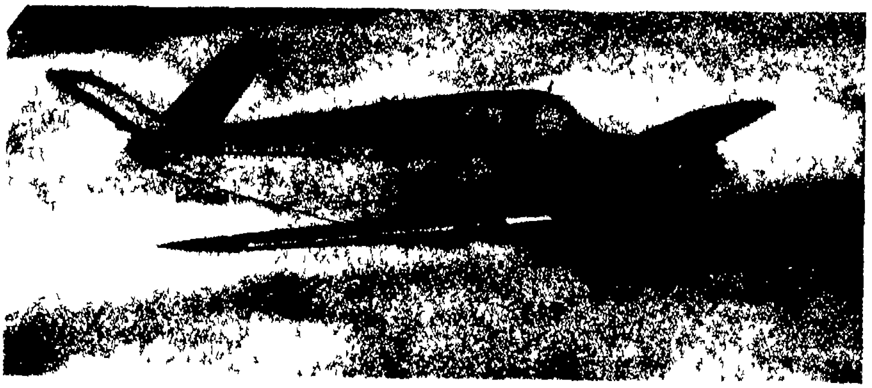
STEEL TROUBLES

Stem from Alloys Found in Scrap

STEEL men are whispering among themselves that the "pure" carbon steels may very largely disappear from the market, with resultant troubles at metals cutting equipment and in the heat treating room.

A "pure" carbon steel, such as the widely used Number 1020, is one which contains no significant amount of any element other than iron and carbon. Such steels can be made only from pig iron and from scrap metals which do not contain other elements. Pig iron will constitute a somewhat reduced proportion of all melts as our high-grade ore sources are worked out. And as a result of the war, with its demands for high-strength alloy steels, unusually high percentages of all the scrap metals available contain significant amounts of nickel, chromium, and other nonferrous metals.

The problems which arise from this cause will be solved by sharpening the work of the metallurgical laboratory.



Clean lined Bonanza in flight. Note V-type tail

Flying For Business

Personnel Transportation by Air Can be Achieved at Low Cost With Plane Designed for General Business Purposes. Economy, Through Time Saving, May Extend to Even Employees in the Lower Salary Brackets

MANY of the larger corporations have adopted company owned airplanes for executive use; up to the present time, however, there has been a tendency to restrict travel in these planes to the highest paid executives because of the expense of buying and operating the craft. Beech Aircraft, in bringing out the Model 35, called the Bonanza, seeks to popularize the use of the airplane for more general business purposes.

The Bonanza is a relatively small plane with room for four occupants, a range of 750 miles, and a cruising speed of 175 miles per hour. With a permanent pilot employed and a 165-horsepower Continental engine, the following cost estimate has been drawn up on a basis of 600 hours flight per year, including fuel cost, pilot pay, depreciation, maintenance, and insurance:

Total cost per hour of operation	$16.46
Total cost per passenger hour	5.49
Total cost per passenger mile	0.110
Total cost per passenger mile	0.028

If the plane were used 100 hours per month, the cost would go down to less than 1½ cents per passenger mile. Moreover, the statisticians of Beech Aircraft have made some convincing investigations of the commercial utility of the Bonanza. For example: "If a company pays an employee as much as $96 per week, then that company can better afford to send him on a trip in the Bonanza with a paid pilot than to have him take a train to his destination. When two employees travel together, their company can better afford to send them in a Bonanza rather than by the normal time-consuming surface means of transportation, even if the rate of earning is as low as $20 per week per individual."

Although this sounds rather startling, yet the calculations are apparently solidly and conservatively made. In this light, airplane transportation for salesmen would seem to be a promising field.—*A. K.*

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CARS FOR 1950

Now in Plan Stage,
Have Genuine Innovations

ENGINEERS addressing a recent meeting of the Society of Automotive Engineers pictured what could happen in the design of future motor cars. Discussion subjects included cars equipped with supercharged engines, engines with extremely high compression ratios, and cars with independent wheel suspensions, hydraulic steering, and rubber torsion springs.

It was pointed out that present and prospective motor fuels offer real possibilities for high fuel economy and great power output. Gains potentially are similar, it was explained, whether superchargers or higher compression ratios are employed. Here, short, compact "V" or opposed engines of 8.5 compression ratio operating on fuels in the 100-octane range appear to be inviting, especially by way of fuel economy, which further could be enhanced by progress in designing automatic transmissions.

Exhibited and described by The B. F. Goodrich Company were "Torsilastic" springs consisting of rubber cylinders bonded internally to central shafts and externally to outer shells, either of which is held stationary and the other rotated by a wheel support arm. Front suspension of a car so equipped was disclosed to comprise single wheel-support arms mounted diagonally from the dash on the outer member of cylindrical, rubber torsion springs.

Steering was said to be accomplished by two balanced hydraulic circuits, one comprising a hydraulic tie rod between the front wheels, the other a pump circuit, with both kept under minimum positive pressure by a spring-loaded reservoir.

Rear suspension was described as of the independent, swinging-axle type, with a universal joint at each wheel. A hydraulic constant-level mechanism, applied to all four wheels, was reported to maintain the designed chassis height regardless of load or of movements of wheels and springs.

STEEL TEMPERATURE

Measured in Furnace
By Water-Cooled Pyrometer

MORE uniform products of steel from the slab to the finishing processes are said to be assured by the use of a new steel surface pyrometer. This radiation-type heat recorder takes the external temperature of nearly white-hot slabs of steel as they pass in review in the heating furnace, preparatory to entrance into rolling mills.

In addition to making certain that slabs reach the prescribed temperatures in their progress to forming and fabricating operations, the new pyrometer will aid research in the design of effective furnaces, locating heat leaks and other points of inefficiency. The long-handled, mallet-like instrument, which may be operated by one man, is designed to perform successfully up to a slab surface temperature of 2400 degrees Fahrenheit.

As explained by the inventors of this instrument at the United States Steel Corporation of Delaware, the surface temperature of a furnace-hot steel slab is so great it must be measured by the radiation reaching a specially designed radiation tube through a lens lodged inside the pyrometer's cylindrical head, the reading being transmitted by wires through the long handle to a recording potentiometer The head itself, 8¾ inches high by about 4 inches in diameter, is water cooled Except for the orifice containing the lens, the working surface is of polished stainless steel backed by asbestos and stands upon three squat stainless steel legs

By means of its handle, the pyrometer is thrust through a door into the furnace to come to rest on its feet above the area whose temperature is sought It is desirable that readings be taken quickly, and this can be done it is reported, in three to five seconds when used with a high-speed recording potentiometer Complete assembly of the radiation unit within the head was calibrated in the laboratory by using as a target a heated plate, whose temperature was measured by a platinum platinum-rhodium thermocouple It is believed that the accuracy of the assembled unit is about plus or minus 5 degrees, Fahrenheit, as long as the surrounding temperature of the radiation tube is kept within the range of 80 to 110 degrees Fahrenheit

Radiation head rests on heated slab

VISIBLE INFRA-RED

Produced by Phosphor Containing Lead Key

INVISIBLE heat rays are made visible by the presence of lead in a material which glows after exposure to light, according to Dr Gorton R Fonda, of the General Electric Research Laboratory, and it is thought that this may help in equipment with which to see in the dark

Waves of infra-red radiation are too long to affect the eye, while those of ultra-violet are too short The latter, however, may be made visible by the phenomenon of fluorescence, used in the fluorescent lamp Here, ultra-violet rays, generated inside the tube, fall on the "phosphor" with which the tube is lined, and there are changed into visible light

Since changes of this kind must always be from shorter to longer waves, fluorescence by itself cannot make infra-red waves visible, it can only make them still longer There is, however, an indirect way in which they can make a phosphor emit light

Some of these materials show phosphorescence—the emission of light continues for a time after the original radiation has been removed If while the glow remains, the phosphor is exposed to infra-red the brightness may be very slightly increased After that it quickly fades out

Dr Fonda's research was concerned with a different type of excitation, reported originally by Franz Urbach, of the University of Rochester Even after the original glow has faded completely an exposure to infra-red causes emission of light Dr Fonda has found that the effect occurs with zinc sulfide, a common phosphor, provided it contains a fraction of a percent of lead

With ordinary fluorescence, electrons in the atoms of which the phosphor is made are knocked out of their normal orbits and into higher states by ultra-violet rays As they fall back to their usual position fluorescence occurs With phosphorescence the electrons are delayed in their return According to Dr Fonda, in the kind of action he has been studying the electrons are "trapped" in a higher state, from which they are released only by infra-red rays, provided the lead "key" is present. The light given off is green in color

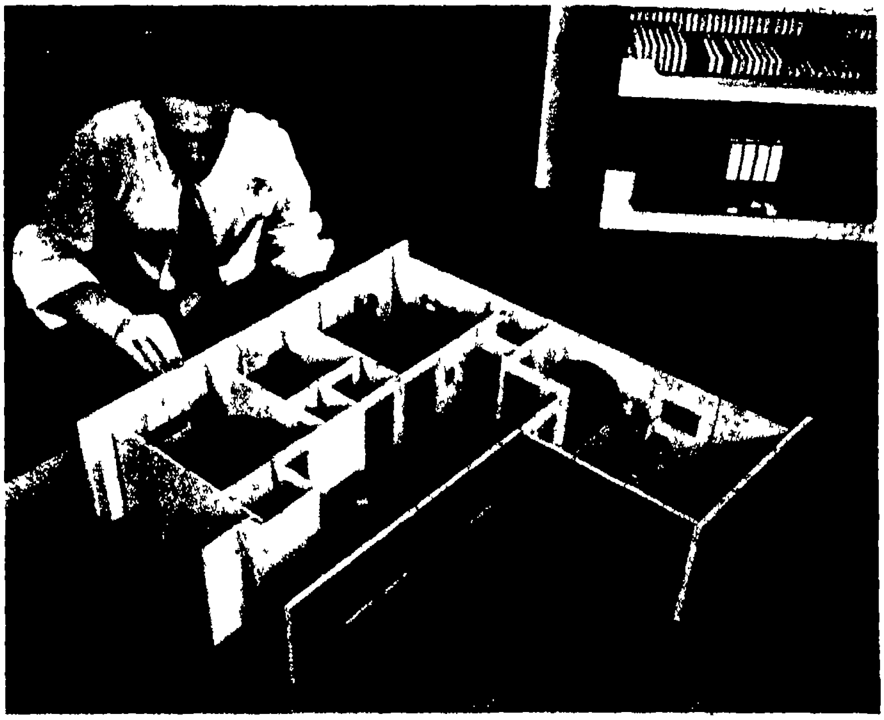
With the "sniperscope" and "snooperscope" developed during the war, vision in total darkness was possible The subject was illuminated with infra-red, and a special electron tube combined with a telescope made the scene visible It seems possible that similar effects could be obtained with the infra-red-sensitive phosphors

X-RAY MODEL KIT

Permits Planning of Most Efficient Layout

COMBINING techniques of model builders and industrial architects with lessons learned in time-and-motion studies a new system of "three-dimensional planning" has been devised to assist in rehabilitating and expanding presently inadequate X-ray facilities The new system, to be offered first to the medical profession and under consideration for industrial X-ray users as well, eliminates the flat two-dimensional drawing or blueprint from early planning and substitutes, instead, tiny scale models of apparatus partitions, floors, and outer walls

The advantage of using models for this purpose is that it permits duplication of existing or proposed facilities in miniature and makes possible endless arranging and rearranging until each room and every unit of apparatus is located for best utilization of available space and maximum operating efficiency According to the developers Westinghouse X-Ray Division, three-dimensional



Based on a one inch to the foot scale, models aid in visualizing layout plans

ning represents a new approach the location and use of X-ray facilities

The planning kit resembles properties of a miniature theater with nearly 1000 individual pieces, each scaled so that one inch represents one foot of actual size. Floors—slotted to permit any wall arrangement—simulate coral tile, walls are of hospital green with tiny Venetian blinds at windows, and miniature X-ray apparatus, desks, files, and office and waiting room furniture add to overall realism.

PLASTICS MACHINE WAYS

Outwear Metal, Retain Accuracy Under Heavy Use

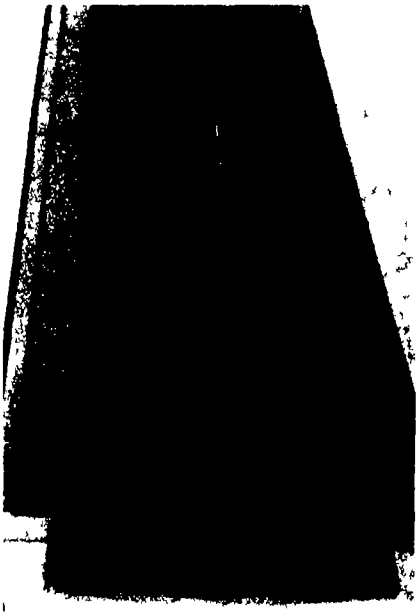
IN THE metal-working industries cutting, scoring, and undue wear of machine-tool ways has been an important problem for years—not only because of the constant maintenance necessary, but also because the accuracy of a machine tool depends upon the accuracy of its guiding ways. Now, it is reported that these troubles have been virtually eliminated by a new non-metallic table way developed by The G. A. Gray Company.

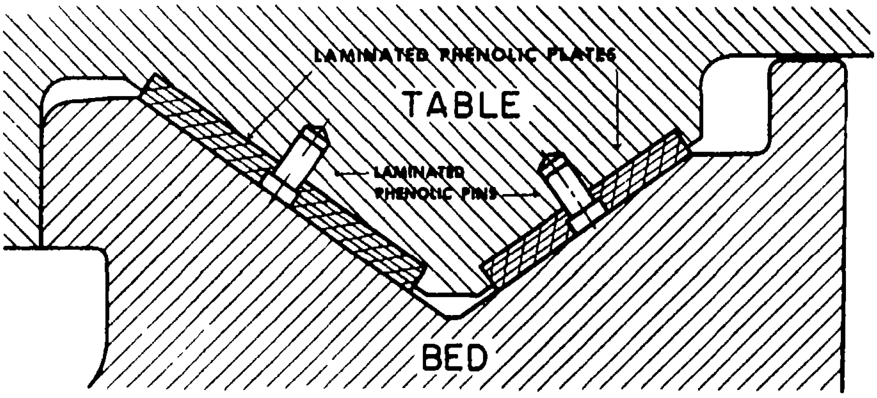
The bearing surfaces of the ways of the table consist of laminated plastics, produced by the Formica Insulation Company from fabric impregnated with phenolic resins. These plastics plates are secured to the table by laminated plastics pins. Exhaustive tests of laminated plastics in use as bearings in heavy equipment for mining and steel mills, on naval and merchant vessels, and on railroads, trucks, and buses, have shown that this material possesses excellent non-scoring and wear-resistant qualities.

Consequently, wear on the non-metallic table way is negligible and the danger of cutting and scoring is reduced to a minimum. One planer table, for example, with phenolic laminated plastics ways, was used continuously day and night for over a two-year period. Although used for the heaviest work with a normal return speed of 380 feet per minute this particular planer showed no evidence of wear. In another test, a table with laminated-plastics ways was subjected to a load of 50 tons. Results from previous tests proved that this excessive load scored cast-iron ways in a short time but the plastics ways remained unaffected, even at high speed operation.

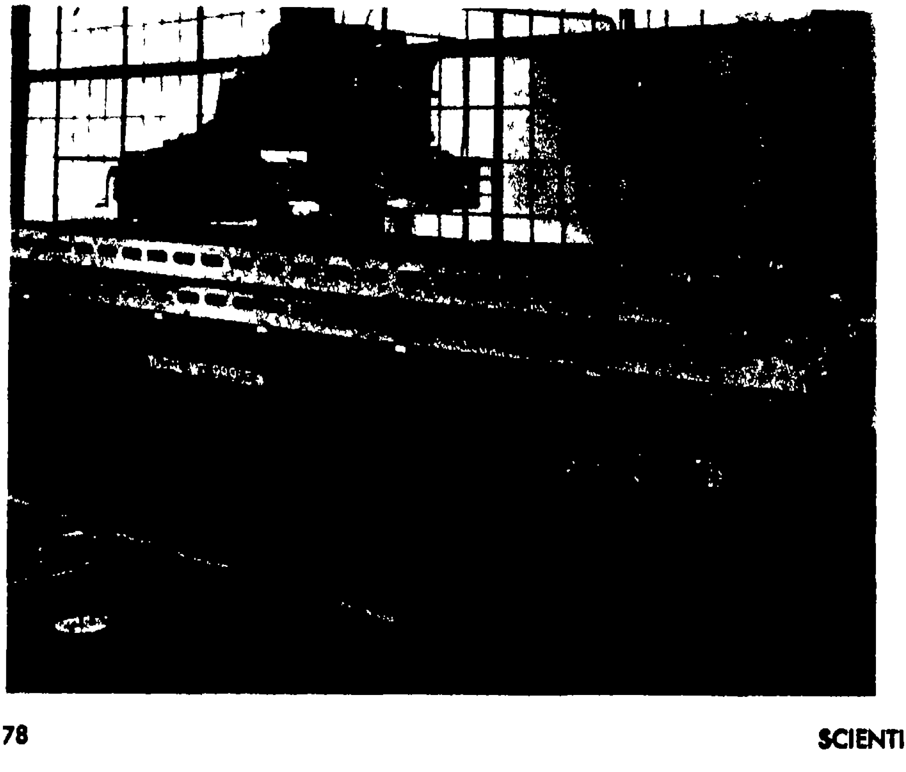
Due to the low friction of these plastics plates, and their low heat transmission, practically no heat is transmitted from the way surfaces to the metal table. Thus, accuracy of the planer work is not curtailed, and the table can be run at almost any feasible speed without danger of the table curling from the heat generated at the bearing surfaces.

Used continuously for two years, the planer (right) shows no wear. Laminated way plates retained by phenolic pins (below). Even under a 50 ton test load (bottom) ways were not worn





Illustrations courtesy Bakelite Corporation

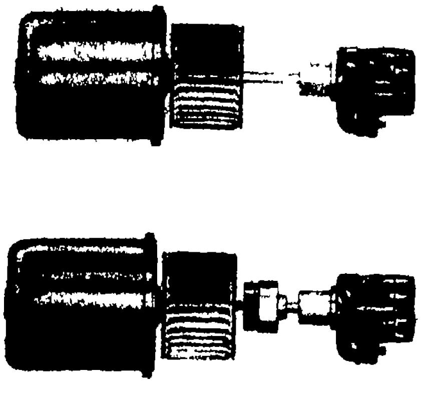


OIL-BURNER ECONOMY

Improved by Centrifugal Oil-Pump Motor Clutch

EQUIPPED with a foolproof automatic clutch which operates by centrifugal force a new oil burner has been described as capable of saving 10 to 24 percent on fuel. Also, it promises greater cleanliness by eliminating the heavy deposits of soot which can rob oil-heating plants of considerable efficiency.

In describing the Economy Clutch developed by the Gilbert and Barker Manufacturing Company, it was pointed out that with the operation of the conventional gun-type burner, the usual fan and fuel pump are attached directly to the motor shaft. Under this arrangement, when the thermostat calls for heat, all units—oil, air, and ignition—start up simultaneously. Thus, fuel oil reaches the combustion chamber before the fan has had enough time



Usual oil burner assembly (top) Same unit (below) with the clutch installed

to attain full speed and deliver a sufficient quantity of air to assure complete and even combustion This poor, uneven initial combustion creates smoke and sooting of heating areas within the furnace or boiler When the thermostat turns the unit off, smoking and sooting again take place, engineers declare

To eliminate these conditions, the new burner's motor shaft is in two sections with the Economy Clutch separating the pump from the fan and motor The starting of the burner motor simultaneously sets the air fan in motion An instant later, when the fan is delivering sufficient air for complete and even combustion, the clutch goes into action and by centrifugal force engages the fuel pump The purpose of the delayed-action operation is to guarantee an abundance of air when the fuel and air mixture is ignited, thus eliminating smoking and sooting from unburned oil

The clutch action is reversed when the burner is turned off The fuel pump is first to stop operating while the fan is still rotating for several seconds after the fuel has stopped

RAY-TRACER OF ATOMIC FISSION

(*Continued from page 56*)

insufficient, which often is the case a *second* amputation will have to be performed to remove the knee Radioactive sodium, and the Geiger counter, tell the surgeon just where he may safely amputate

Medical circles today fairly buzz with talk of these radioactive tracers, and the work that is being done with them From these studies a deeper understanding of the human body and its ailments is emerging Doctors are finding out just what happens to a drug when it is injected into the bloodstream "Tagged" with a tiny amount of a radioactive tracer, the drug can be followed to whatever part of the body absorbs it, and the amount and rate of absorption can be definitely determined We know more about the bloodstream and its composition than ever before, more about the cell structure of living tissues, more about almost every nook and cranny of the human body because now medical men can *watch* things happen, and need no longer guess In a number of large hospitals where pioneer work with radioactive tracers is now in full swing, Geiger counters are already a common sight But we are destined to see many more of them The atomic age is upon us and the curious little-heard-of invention of Hans Geiger is very much a part of that age

IN INDUSTRY — Radioactive tracers have already been put to a number of industrial uses They are uncannily successful in following the bulk movement of a gas liquid or solid For example, by adding a small amount of radioactive gas and "tracking" it with a Geiger counter, engineers can follow the flow of gas through the most complex maze of pipes and reactors

Or let us say that the engineers of a chemical firm are puzzled by the fashion in which copper disappears from a solution as it flows through a system of pipes They want to find out exactly where the copper is being lost A small amount of radioactive copper is added to the solution It will travel with the normal copper and be lost in the same place The region where the loss takes place is located by a Geiger counter, sensitive to the gamma rays emitted by radioactive copper

In steel refining, the use of radioactive tracers simplifies the troublesome problem of frequent chemical analyses In the past, these time-consuming analyses often delayed the process Now, by adding radioactive phosphorus at the start of the refining process, it is possible to obtain simple and speedy analyses by radioactivity measurements

Oil refineries have already used radioactive hydrogen as a tracer, and have obtained priceless information as to what goes on in the process of "cracking" petroleum A broader knowledge of what occurs to the complicated hydrocarbon molecules during the cracking process may ultimately lead to amazing new developments in the petroleum industry

The chemical industry, in large part based upon organic chemistry, should find a valuable ally in radioactive carbon With it, chemists may discover just what happens to carbon compounds during a host of chemical reactions Such a study is certain to result in basic advances in the field of organic chemistry, and eventually in new products from the chemical industry

These are but a few examples of the part radioactive tracers can play in industry, just as they are playing in medicine And in using such tracers the Geiger counter is indispensable

Whatever the future brings, the Geiger counter will be used to save lives Whether it is used in the fury of an atomic war, in hopeful quiet laboratories and hospitals, or in industry is up to us

COOLANTS FOR CARBIDES

Seldom Needed, But Require Proper Handling When Used

THAT best results when machining with carbides are generally obtained by cutting dry, but that coolants may be needed on certain jobs where it is necessary to maintain a high degree of dimensional accuracy, was maintained by Fred W Lucht, Development Engineer of Carboloy Company, Inc, at a recent meeting of the A S T E When used, however, coolants should be supplied in large quantities never in "dribbles"

If a coolant is needed to prevent distortion of the workpiece, the use of a solution consisting of one part soluble oil and 30 to 40 parts of water was advocated This variation in the proportion of water to oil is made necessary by the variations in hardness of water in various parts of the country Also the mixture in such proportions keeps the ways of the machine tools free from rust

It was further stated that when using this soluble-oil solution, a copious flow of the liquid should be directed towards the cut underneath the tool, or at the cut from the side of the tool where the chip flow has the least tendency to interrupt the path of the cutting fluid An intermittent flow of the coolant--whether caused by an inadequate flow, an "umbrella" action of the chip, or any other reason—always tends to reduce tool life, it was pointed out

Mr Lucht added that the soluble-oil solution has given good results on all types of carbide machining operations except gun drilling Here, experience has shown that the regular cutting fluids which are normally used for gun drilling give the longest drill life also with Carboloy drills

New Products and Processes

VIBRATION METER

Measures Displacement, Velocity, and Acceleration

Wide acceptance of means of measuring vibration by electronic methods to determine the efficiency of a product or process has prompted development of a new vibration meter which accurately detects sources of wear, strain, and noise in new product development and in equipment manufacturing or test processes. Its use should help reduce rejections, prevent breakdowns, and aid in lowering production costs.

Vibration detected on production basis

Called the Model 11-B Vibrometer the device is an integrated amplified vacuum-tube voltmeter with a cable-attached search prod. It registers all three types of vibration—displacement velocity, and acceleration—on a calibrated meter scale. The Vibrometer prod is equipped with interchangeable fittings which permit numerous applications.

For field, laboratory or production use, the instrument weighs 31 pounds and is 17 inches high, 12 inches deep, by 11½ inches wide. It operates on 105-125 volt, 50-60 cycle, current.

An output jack is available at the rear of the Vibrometer for use with phones, oscillograph, wave analyzer, or recording devices.

FABRIC-SPRING TUBING

Provides Light, Flexible Duct for Gases or Solids

A simple, inexpensive portable vacuum cleaning unit can be constructed by making use of the light weight and flexibility of a non-collapsible fabric tubing called Spiratube.

In one such application in the cabinet-making department of a clock manufacturer, the vacuum cleaner is used to pick up sawdust, shavings, and chips and convey them to the main exhaust line. The flexible tube has on its discharge end a sheet-metal adapter with lugs which fit into a bayonet slot in the main exhaust line. The intake end of the tubing is clamped to a metal nozzle, on which a metal strap is bolted to serve as a handle.

Sharp turns, no crimps

Made by The Warner Brothers Company the tubing is adaptable to a variety of semi-permanent and permanent installations for conveying air, gases, and light solids. It is self-extending and retractable. A thermoplastic-coated duck fabric is spiral-stitched around a single continuous helical spring core. The flexibility of this construction is said to permit extremely sharp turns with minimum crimping and reduction of free area. The wire-free inside channel prevents solids from collecting and obstructing flow.

DETERGENT LUBRICANTS

Reduce Wear on Marine Inboard Engines

Lubricants with additive compounds completely soluble in the oil which keep engines clean by preventing undesired deposits and protect against corrosion of alloy type bearings are designed to improve performance of pleasure-craft inboard engines, both gasoline and Diesel, at reduced operating costs. They prevent rusting of the lubricated surfaces and reduce wear on cylinders and rings.

After refining from selected crude sources, the additive compound is incorporated in the oil, providing several important characteristics not obtained in straight mineral oils. The result is a lubricant which keeps new engines clean and provides a cleansing or dissolving action which reduces or removes previously formed deposits from used engines. In addition, the chemicals keep the finely divided particles resulting from fuel combustion and oil decomposition suspended in the oil so that instead of settling out in the engine they are removed at regular oil-change periods.

By promoting engine cleanliness, the new oils eliminate sticking of piston rings which causes scored cylinders or liners and wear on cylinders and rings. Maximum power output is attained with savings in fuel and lubricant consumption as well as the expense of frequent overhauling.

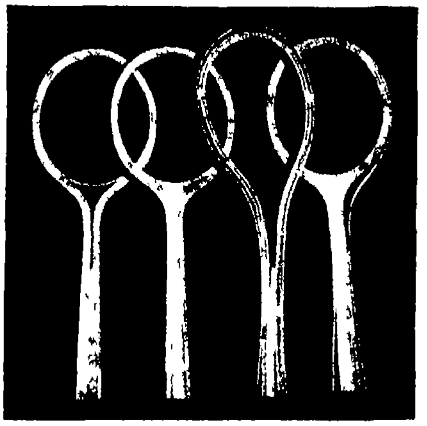
The new oils, produced by the Texas Company, meet the lubrication requirements of all gasoline inboard engines from the small sizes with two or four cylinders to large engines of several hundred horsepower. In addition, they meet the demands of all high-speed Diesel engines in pleasure craft and many lower speed Diesels having a single lubricating system.

WATER-RESISTANT GLUE

Proves Superiority in Accelerated Tests

Animal glues failed while a synthetic resin adhesive provided a perfectly satisfactory bond, when both adhesives were subjected to accelerated water resistance tests. Tennis racquet frames, which must be strong and durable, and highly resistant to deterioration from varied weathering conditions, were chosen as the medium for the test. Although tennis racquets were made from solid wood in years past, modern technique is to laminate them from thin strips of veneer in order to obtain greater strength and to prevent warping.

Either animal glue or Urac 185 can be used for the laminating operation inasmuch as both require little pressure and have "gap filling" characteristics, making possible the joining of parts where perfect fitting is not always feasible.



Racquet frames used in glue tests

Test conditions were as follows. Synthetic resin bonded racquet (left) was soaked for 105 minutes in water at 160 degrees, Fahrenheit. There was no delamination and no discernible deterioration of the bond.

Animal glued racquet (second from right) after soaking for the same length of time at the same temperature showed complete delamination and had to be held together with tape.

The other two racquets in the picture were soaked for 24 hours in water at room temperature with the results shown

For such applications as the assembly of station wagon bodies, boats, sporting goods, prefabricated houses and other uses where water resistance and permanence of bond are required, this resin adhesive has proved to be a worthwhile addition to the tools of the woodworker's craft

LIGHT-RESISTANT BROWN

For Paint, Promises Many Coloring Applications

Brighter, cleaner, and more durable shades of brown colors for industrial enamels, trim paints, wallpaper and other coated papers, textiles, and possibly plastics are forecast in an announcement of a new pigment color under the name "Auric Brown"

The pigment—chemically hydrated ferric oxide—is characterized by an extremely small particle size, and promises outstanding resistance to light for a wide range of products According to the Du Pont Company, it is non-bleeding in the usual paint, enamel, and lacquer finishes Also, the new brown is expected to show less tendency to chalk from outdoor exposure than standard iron-oxide pigments

All the possible uses of the pigment have not been explored, although it has been shown to give very fast-to-light shades on coated and other papers such as those used for wallpaper In addition, this brown pigment is expected to find use in emulsion paints show-card colors and possibly plastics Linoleum, tile rubber and printing inks remain to be investigated as possible fields of application

FLOOR MACHINE

Built Low to Reach Tight Spots, Avoids Bumping

An extra-low disk-type machine of new design, for floor polishing scrubbing, steel wooling, and other maintenance, has a special side-polishing brush which cleans and polishes flush with the walls, even polishing the baseboard

Brush cleans desk legs, baseboards

The brush, which has bristles extending beyond the circumference of the disk and approximately two inches high, eliminates bumping and scratching furniture It also permits fast, easy operation under crowded conditions

The machine has been kept to an over-all height of less than 12 inches through the use of a "pancake-shaped" motor centrally mounted over the cleaning disk This permits the machine to operate with ease in "inaccessible" places such as under desks and machinery

Another advantage of the brushless, axial air-gap type motor is the ease of control it provides through a stabilizing "gyroscopic" action.

The floor machine, made by G H Tennant Company, has a handy wheel adjustment which allows it to operate in divided weight position with 50 percent of the weight on the wheels, or with the full pressure on the brush The adjustment permits changing brush pressure to meet varied needs Three-inch wheels swing up automatically when the handle is tilted for concentrated weight position

Sturdily built for use on all types of floors, the machine accommodates—for rug cleaning—a steel tank which holds water and soap solution for scrubbing The liquid feeds to the center of the brush on operation of a lever and flows uniformly through the bristles

Other features of the machine include a positive gear drive, splash-proof protection provided by a stain-

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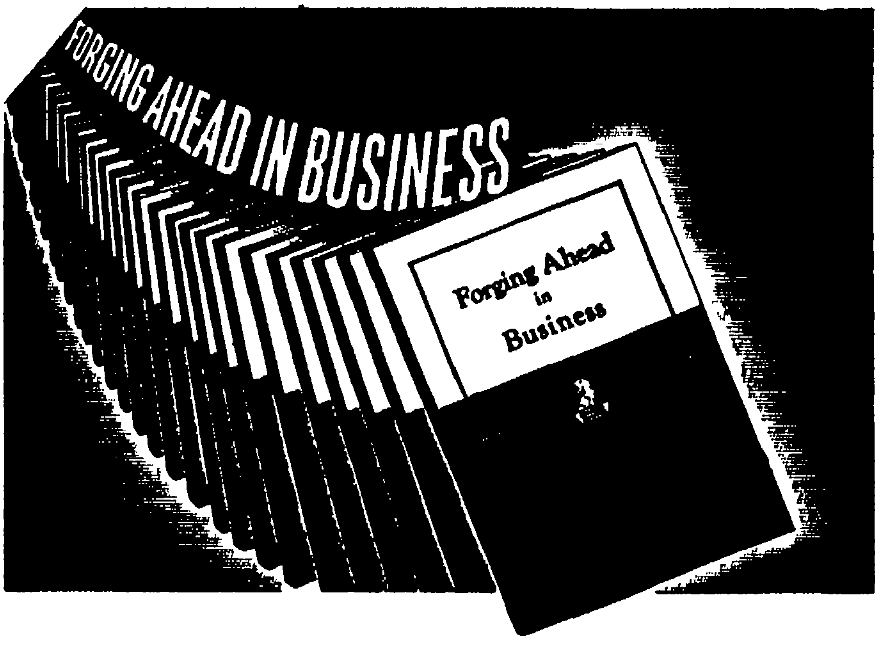

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less steel brush skirt, and an adjustable handle which moves easily to any operating height Weight of the machine equipped for use is about 100 pounds

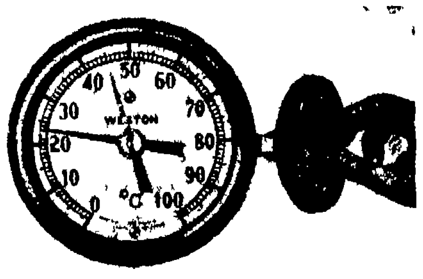
DIAL THERMOMETER

Has Manually-Set Index Pointer

INDICATING maximum or minimum temperatures reached, a new all-metal thermometer has an auxiliary red index which is manually set by a finger knob that protrudes from the center of the scale glass

When a record of the lowest temperature reached is desired, this index is placed to the low side of the temperature pointer The pointer will move the index to the lowest temperature reached during any operating period, and the index will remain at that low point until manually re-set For a record of the highest temperature reached, the index is simply set at the high side of the pointer

This new instrument, called the Max-Min, is now available in two models, with scale diameters of three and five inches respectively It is also available in all the usual ranges, and in stem lengths from 2½ to 48 inches



Temperatures reached are recorded

It is claimed by the manufacturer, the Weston Electrical Instrument Corporation, that this thermometer fills the need for a low-cost device which will provide an accurate record of high or low temperatures, such as on transformers, sterilizers ovens, chemical equipment, and so on, as well as in many processing operations throughout industry

NEW V-BELT CONTROL

Provides Greater Speed Selection

TWO STANDARD cross-section V-belts and four variable-pitch pulleys make up a new planetary power transmission unit which provides infinite ratio, stepless speeds from full to zero and into full reverse at constant torque Of two-horsepower capacity, a slight change in the variable-pitch pulleys of the Speed Selector brings a large change in output speed through the multiplying action of the planetary mounted on the motor or driven shaft of the machine on which it is used, eliminating need for special mounting brackets, or extra guards.

In operation, the Variable-V-Planetary Speed Selector system compares the ratios of two V-belt drives and applies the difference in speed to output

Editorial purpose of Scientific American is to provide its readers with thought provoking feature articles and shorter items on all phases of industrial technology In every case the material is drawn directly from industry itself The Editor will be glad to refer interested readers to original sources and when available, to additional literature, giving further details of a more specialized nature

shafts With the ratios equal the difference in speed and output shaft speed is zero If the ratio of one drive is greater than the other the output shaft rotates forward at a speed proportionate to the difference in ratios If the ratio is less the output shaft operates in reverse in the same proportionate ratios Speeds from 400 revolutions per minute to zero, forward and reverse, can be obtained

All changes are made by a hand control wheel, which alters the pitch diameter of the center pulleys so that as one is increased the other is decreased and the change is imparted to the outer pulleys by the wedging action of the V-belts The control is mounted on the input shaft of the driven machine by a tapered collet The wheel thus controls diameter of all four pulleys without use of springs or complex linkages

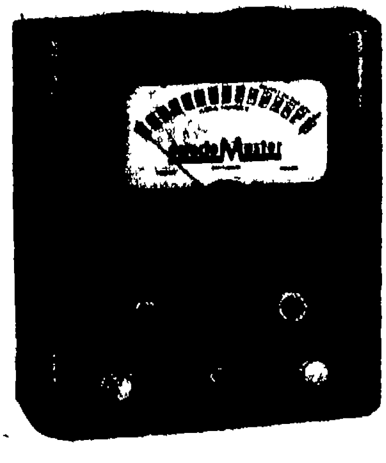
Frame construction of this Variable-V-Planetary, a development of the Speed Selector, Inc, and The B F Goodrich Company, is of light-weight aluminum with cast iron sheaves for long wear

THERMIC FIRE ALARM

Offers New Safety
To Farm and Industry

CONTROLLED by a network of thermostats, a new fire-protective system for homes, farms, and industrial plants warns of dangerous changes in temperature, in addition to serving as a fire-warden The thermostats are spotted in 15 strategic locations about the property, with one control and indicator unit at a central point.

When outbreak of fire causes a critical temperature rise at any one of the "hot" thermostats, the message is transmitted to the control unit which rings a bell, switches on a red light, and designates on a meter dial the location of the trouble The watchman or farmhand thus can render instantaneous attention, an important factor in fighting all fires


Shows location of fire

Standard equipment includes 15 master thermostats, one for each of the locating areas on the meter, but extra auxiliary thermostats can be obtained, with virtually no limit on the number it is possible to use in the one system Up to 300 auxiliary thermostats may be wired into a single area, each thermostat being effective for an area of 4800 cubic feet

There are also "cold" thermostats which warn against dangerous drops in temperature

A final safety feature provides that if a wire or thermostat is accidentally broken somewhere in the system, known as the Detecto-Master, the alarm bell will ring, the red light will flash and the dial-needle will register the area of damage, just as if a critical temperature change had occurred

TRUCK SEAT

Eases Job for Long-Haul
Drivers, Fits Most Cabs

COMBINING a direct, double-action hydraulic shock absorber, variable-rate coil spring to accommodate a driver of any weight, and an alloy torsion bar-steel sway bar, the entire assembly of a new truck seat is rubber mounted and guided, up and down, on frictionless bearings

Spring adjusts for driver's weight

The truck seat is available for installation on most makes of trucks built since 1938 and on models ranging from light duty to heavy duty, cab-over-engine types, and others used as cross-country haulers, truck-trailer fleets, food trucks, oil trucks, farm trucks, and automobile carriers The unit, made by the Monroe Auto Equipment Company, is a companion to a similar type of seat made for tractors

MASONRY DRILLS

Use Carbide Tips,
Now Cost Less

AN IMPROVED line of masonry drills now includes 15 sizes, ranging from 3/16 inch nominal diameter to 1½ inch nominal diameter—sufficient over-size allowances are provided for proper hole size required for installation of such devices as expansion shields, anchors,

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and toggle bolts The price on each drill size has been reduced some 40 percent below previous levels, and the new Carboloy drill design features a solid round shank without flutes which gives greater strength and maximum possible support to the cemented carbide cutting tip

It is reported that the round shank actually gets dust out of the drilled holes better than the former fluted design The drills come individually packaged, together with complete operating and service instructions The six most commonly used sizes are available in a sturdy canvas kit, the set comprising 3/16 through 5/8 inch-nominal-diameter drills

The Carboloy masonry drills are designed to be used in any rotary portable drill or hand brace, thereby eliminating noisy, time-consuming hammer-and-chisel work This feature makes it possible for workmen to use the drill during business hours with a minimum of disturbance to the building occupants

FLASHLIGHT CELL

Contains Improved "Mix," Doubles Former Capacity

A HIGH-ENERGY general purpose flashlight cell which is said to have double the capacity of its predecessors with no increase in size is based on an improved chemical mixture contained in the cell

Each cell, of 1 1/2 volts, weighs only 3 1/3 ounces In this limited space are packed 10,890 foot pounds of energy according to the National Carbon Company, Inc

TRANSVERSE TESTER

Applies Load Automatically, Registers Breaking Point

A CAPACITY up to 10 000 pounds, hydraulic operation, and high sensitivity are features of a new transverse-testing machine with equal accuracy and efficiency on various specimens up to its full capacity

The machine, Model TR-1, made by Steel City Testing Laboratories, is easily operated and supplied with electric-motor drive at voltages to suit available supplies The load is applied automatically, at speeds selected by the operator

Controlled transverse loads

A gage is furnished on which a maximum-indicating hand remains stationary when the specimen breaks, permitting the operator to get accurate readings even though he is not looking at the dial when the ultimate breaking point is reached Gages may be calibrated in kilogram loads if desired

CENTER DRILLING TOOL

Features Automatic Centering To Simplify and Speed Production

A HIGH production center drilling machine with automatic centering and clamping is reported to be so simple in operation that a minimum of skill is required, enabling "green" operators to do concentric centering on a wide range of stock sizes Contributing to the high productivity of the Detroit Tap and Tool Company's machine is the use of only a single lever to control all operations, including automatic positioning, clamping, and feeding the drill

Skilled operator not needed

The self-centering vise automatically clamps the work in concentric alinement with the centering drill The vise is actuated by an hydraulic cylinder, controlled by a three way valve actuated by an extension of the drill head feed lever Two racks mating with a fixed pinion transmit opposed vertical motion of exactly equal amounts to the upper and lower V-block jaws of the vise One of the racks is integral with the hydraulic cylinder plunger rod True vertical alinement is maintained by mounting each of the jaws of the vise on hardened and ground adjustable ways

The jaw opening for loading is adjustable to maintain minimum travel of the clamping V-blocks, thereby making the clamping of the stock practically instantaneous The hydraulic cylinder is of special construction so as to give a "cushioned" grip on the stock

The drill head is of the cartridge type with high precision ball bearings and travels on hardened and ground adjustable ball bearing ways The drill

has three speeds—1250, 2400, or 5200 revolutions per minute—obtained through a V-belt step pulley drive from the spindle drive motor Another motor drives the gear type hydraulic pump through a flexible connection Drilling depth is quickly adjustable

BROACHING TOOL

Rotary in Action, Has Long Cutting Life

MADE with high spiral or helical cutting edges, a new broach, when end pressure is applied, is said to remove metal in a true shearing manner Called a Shearcutter Rotary Broacher,

For producing true, round openings

the device is described as producing accurate holes with an excellent finish

The cutting edge of the broach forms a circle, consequently there is no tendency to produce elliptical, bell-mouthed, or uneven holes Savings in production costs and a cutting-edge life five to ten times longer than ordinary tools, before regrinding is necessary, are other features claimed for the tool

GLASS-MICA PLASTICS

Formed to Variety of Shapes by New Techniques

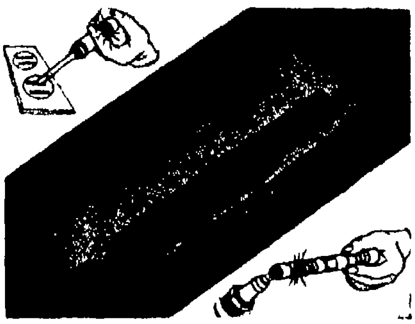
ADVANCES made in the injection-molding processes of mycalex, a ceramic-like plastics, and improved methods that have resulted in reduced tool costs now promise to increase the material's economic practicability Previously the General Electric material in molded form was used almost entirely for electronic equipment because of the limited number of shapes which could be produced Now, it is reported possible to mold the material into a much greater variety of shapes

Suggested uses have been enlarged to include rotating equipment, control equipment, heating devices, motor parts welding equipment, and insulation for aeronautical ignition equipment Mycalex is a stone-like product composed of ground mica and a special glass It can be molded to the desired shapes with or without metal inserts by either the compression- or injection-molding processes and can be machined

CIRCUIT TESTER

Combined with Screw Driver In Convenient Tool

ONLY one hand is needed to test house and commercial currents, appliances, electric fixtures or automotive spark plugs with a new combination electrical testing instrument and screw driver A neon bulb housed in the Catalin case of the tool lights up to indicate electrical current When the cap, which also is constructed of Catalin, is unscrewed, the screw driver is exposed and made ready for use The tool-steel shank is covered with a plastics insulating sleeve



Dual purpose, safe to use

In testing house and commercial current, the cap is removed and the screw driver tip placed in the socket or on the wire being tested To test spark plugs the unit is left intact and the screw on top of the cap is touched to the plug The glow of the neon bulb indicates a current flow Called the Tes-L-Amp, the tool should be of aid to automobile and aircraft mechanics, electricians, and so on

BLOWN RUBBER

Is Ideal as Refrigeration Insulator

LIGHTER than cork, and resistant to fire, rot, acids oil, vermin, and termites, a new insulating material is available for use in refrigerators and freezing units This material, known as cellular rubber can be made in either hard or soft form, and is said to be more effective as an insulator than cork It will not absorb moisture, and therefore is especially recommended for refrigerator trucks where present insulating materials absorb hundreds of pounds of moisture adding considerably to the gross weight of the vehicle

Cellular rubber is made by an expanding process in which chemicals containing nitrogen are mixed into a mass of rubber The nitrogen upon release acts as a blowing agent producing thousands of microscopic cells, each one separated from its neighbor

During the war cellular rubber was

Light weight insulating board

Are these things
SUPERSTITION

...or Strange
Natural Law?

THE PREMONITION or strange feeling that preceded the death of a relative the incident you *remembered* before it happened Have you had these or similar experiences? Are you brushing them aside? Can they be explained in such vague terms as superstition or supernaturalism? *Or,* are there *natural laws* of mind governing these things?

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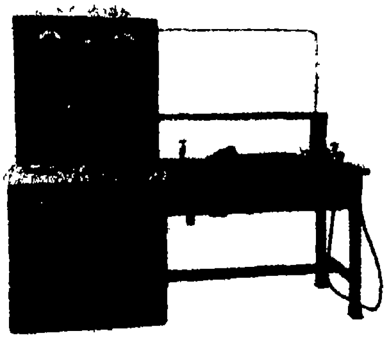
used in the production of light-weight domes to protect delicate radar equipment and in the wings of airplanes as supports for fuel tanks Not until now has this product of the United States Rubber Company been available for civilian insulating purposes

PLATING LABORATORY

In Miniature, Facilitates Control Tests

DESIGNED for either routine control of plating solutions or the most exacting research work on electroplating problems and processes, a new control table laboratory unit can plate test panels under closely controlled conditions so that the results of additions, impurity removal treatments, and variations in operating conditions can be observed



Control table aids in close observation of electroplating operations

The Diggin Electroplating Control Table consists of a modern laboratory table, constructed throughout of steel, with a special corrosion-resisting finish The working surface is selected calcite-free alberene stone On the control panel are mounted all instruments and service outlets required for electroplating tests The current in each circuit is controlled by a stepless carbon-pile rheostat and an off-on switch A heavy-duty switch makes it possible to connect the entire load to either generator or battery, and by flipping two toggle-switches the generator is connected to the battery for charging An electric timer is provided for accurate timing of tests A red pilot light is in operation during the test, when the selected time interval has expired, a green pilot light goes into operation simultaneously with a warning buzzer

A convenience outlet is located at one side for operating motor-driven stirrers, electric hot plates, immersion heaters, and similar accessories Two compressed air outlets with needle valves are provided for air agitation of electrolytes or for the operation of an air-driven stirrer

INDUCTION HEAT ACCESSORY

Rotates Work Piece, Allows Immediate Quench

COMBINED in a single unit, a compact hydraulic rotary spindle and quench ring is designed for use with any type of induction heating equipment This device simplifies the handling and heat treating of parts requiring rotation during the heating cycle and subsequent quenching while in position

The work piece is located on a spindle which is actuated by a water-driven turbine, fed through standard hose and nozzle attachments at the base of the unit The speed of rotation is controlled by varying the flow of water

Portable, the combination unit can be moved from one coil to another Wherever the operator places the unit, rubber suction cups hold it firmly in position, it is explained by the maker, the Induction Heating Corporation

Further flexibility is achieved by interchangeable quench rings and adaptors, which are available in four sizes, 4¾, 7, 9, and 12 inches inside diameter

Called the Ther-Monic rotary spindle and quench, the accessory through rotation of the work eliminates the necessity for precise location of the work in the coil and insures uniformity of heat treatment of such parts as gears, splines, pulleys, and similar circular pieces

COATING MATERIAL

Supplants Vegetable Oils, Forms Tough, Rubbery Film

A NEW aqueous film-forming material holds special interest for the paint, paper, and textile industries Called Dow Latex 512, it will provide an immediate source of supply to those industries who are facing short supplies of vegetable oils such as linseed

The material is described as a combination of styrene and butadiene which when air dried forms a rubbery and tough film with excellent pigment binding properties and a high protective value Its compatability with many aqueous emulsions or dispersions of resins, oils, varnishes, starches, waxes, casein, plasticizers, and water soluble gums and pigments is another of its important characteristics.

PLASTICS SHIELD

Guards Eyes While Permitting Recovery of Particles

TOUGH and transparent, a Plexiglas device which simultaneously protects workers' eyes from flying metal particles and provides for the efficient recovery of gold particles or "sweeps" in the production of dental appliances

Worker's eyes protected

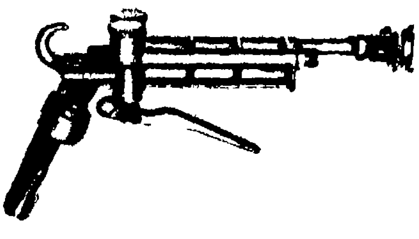
is typical of many guards now popular in industry, because they permit the operator an unobstructed view of his work.

Easily cleaned with soap and water, these transparent plastics shields are an answer to worker-protection problems in fine grinding The shatter-resistant quality of Plexiglas combined with its light weight (one half that of glass) provides the worker with safety protection when working with fast-moving machines requiring delicate or precise operation

AIR-WATER GUN

Speeds Cleansing of Inaccessible Parts

Completely controllable by a finger-tip lever without the necessity for valve adjustments, a new, light-weight air and water gun is designed for economical, time-saving, high-pressure rinsing and removal of loosened dirt and grease from inaccessible parts of equipment and machinery This compact gun is particularly suitable for use in all types of maintenance and repair units in the automotive and aircraft fields It operates on regular air and water pressures and connects to standard fittings Since there are no valves to open or close, no adjustments are required The gun manufactured by Turco Products, Inc fits snugly in the hand of the operator, who merely depresses a single lever to produce a high-pressure spray



No valve adjustments needed

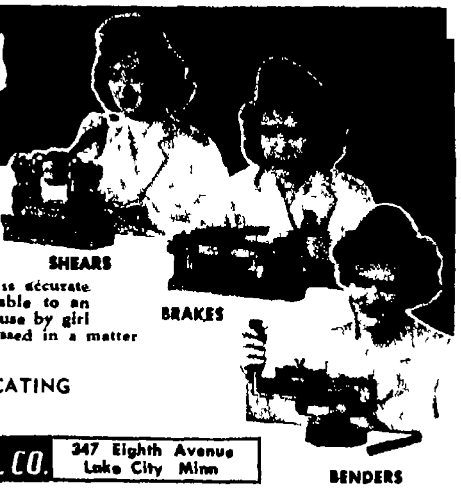
SPRAY-WASH MACHINE

Is Rubber Lined, Carries Parts on Conveyor

Intended for continuous pickling and washing of any metal part requiring surface preparation for the application of enamel or other coatings or for the removal of scale, a new spray-type machine incorporates a conveyor onto which pieces are fed at the entrance to the machine and which carries them through the spraying and washing cycles The pieces emerge acid-free and ready for the succeeding operations

Each cleaning unit is designed individually to suit the particular manufacturing problem and is lined with rubber, according to The B F Goodrich Company The machine has been used successfully for pickling cartridge cases and preparing steel hollow-ware for enameling Advantages cited for the machine over the dip method widely used include straight line operation, materials requiring minimum handling, and standardized production, no special

METAL, *Stampings*



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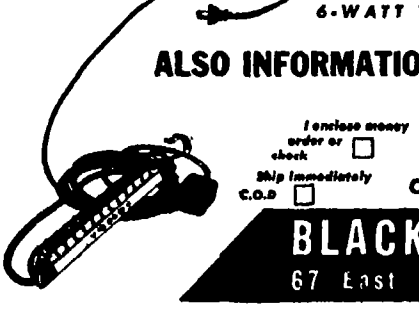

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equipment being required for handling pieces of different shapes and sizes

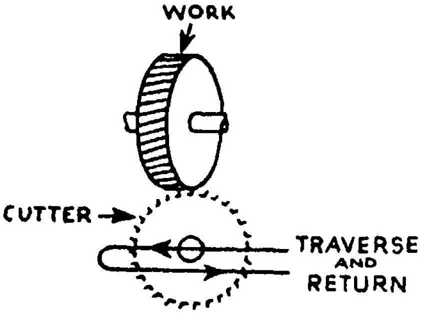
Also, it is said that the spray principle is most efficient, since under pressure it removes scale and foreign material faster and more thoroughly Hollow-ware articles, which tend to float or develop pockets in a dip system, are cleaned completely by the spray process In one operation for example time for pickling is reduced to four minutes from the 15 minutes it required in the old-type dip process

UNDERPASS GEAR CUTTER

Steps Up Production,
Reduces Tool Wear

AN INCREASE in output of 200 percent per gear-finishing machine—brought about by combining underpass shaving and "curve-shaving"—was recently reported by a motor-vehicle manufacturer The gear on which comparative runs were made was a cast-iron timing gear for automobile engines, an 8-pitch, 24-tooth type with a ⅞ inch face Stock removal is approximately 004 to 006 inch over pins

Originally about 36 gears were turned out per hour, but the use of the underpass curve-shaver increased the output to 110 gears per hour Operating on the principle of tangential rather than in-feed of the cutter, the machine does not use lateral cutter reciprocation The cutter is reciprocated once tangentially to the gear while the two are rotating in mesh



Underpass finishing method

Cuts on tangential principle

With axes of cutter and gear crossed, the cutter moves tangentially under the gear Cutting starts on both tooth faces as well as at one end of the teeth as the cutter is moved along the tangent line towards the gear The cut sweeps across the gear face as the cutter moves past the gear, then reverses and sweeps across the gear face to impart the desired finish to the gear teeth as the cutter returns to its original position This shaving method is said to give a smooth, even cut and to distribute wear across the entire face width of cutter instead of concentrating wear on center of cutter, according to the Michigan Tool Company

The cutter automatically produces the desired form without any mechanical action to change relative cutter-to-gear positions since the curve-shaving action that retains the correct involute form but thins the cross section down a few thousandths towards the ends of the teeth is built into the cutter itself

BOTTLE LABEL GLUE

Resists Storage Moisture,
Economical to Apply

DESCRIBED as a "jelly" glue, a new label-machine adhesive is reddish brown in color odorless and supplied in proper body making it ready-to-use in the gum pot The jelly character of the glue provides a tough, flexible, non-crystallizing glue film that withstands considerable water immersion and resistance to the damp atmosphere of refrigerators and ice boxes Its resistance to water makes possible its use on wet bottles, avoiding dilution of the adhesive when applied

Called Cooler-Proof Label Machine Glue, the adhesive must be applied in a thin film to obtain maximum tackiness to hold paper labels in place on the glass This is a distinct advantage resulting in exceptional mileage and coverage per pound One filling of the glue pot is said to serve the average labeler on a full eight-hour shift Returned bottles are easily cleaned of labels and glue through regular washers and soaker equipment without resorting to special cleaning compounds, according to Paisley Products, Inc, the manufacturers

LAMINATED AIRCRAFT WING

May Prove Aid
To Supersonic Flight

REPRESENTING a complete departure from contemporary wing design, an aircraft wing of laminated fiber-plastics, using cellular cellulose acetate as a core, has been successfully tested Cellular cellulose acetate, a lighter-than-cork foamed plastics material, is bonded between skins of glass-reinforced laminates and provides a firm support for these thin, high-strength materials The sandwich-type construction provides an extremely clean interior, entirely free of customary obstructions such as ribs and other structural bracing

The wing, whose construction required only six structural parts, has withstood 105 percent of the required design load without any buckling or wrinkling.

The laminated cellular cellulose acetate, produced by Du Pont, has been found to be a good insulator against noise—a bane of pilots and passengers—and against heat or cold. The insulating properties were said to make the new type of construction especially worthy of consideration in the building of refrigerated freight planes.

Army Air Force engineers say the successful development of the wing demonstrates the practicability of using the new materials for the complete structure of an airplane. Higher speeds, due to the absence of rivets and bolts and the greater rigidity of the sandwich structure, are also predicted.

The plastics wing poses the possibility of finding a material which can withstand the rigors of supersonic flight better than metal. As aircraft speeds get faster and faster, the smoothness of the wing surface becomes more important, since the slightest scratch can set up violent turbulence when the verge of sonic flight is reached.

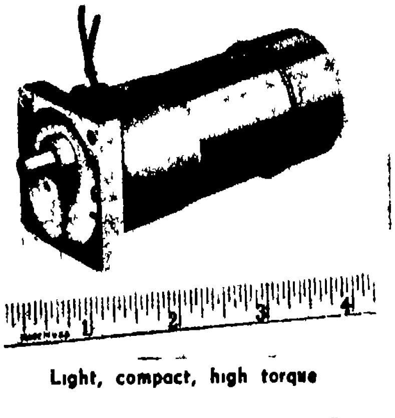
ACTUATOR MOTOR

Allows Remote Operation Of Controls and Switches

A NEW light midget rotary actuator for application in aircraft and other industries, where extreme light weight and small size are primary considerations, weighs only 0.60 pounds, and has been designed for loads ranging from 0.1 to 15.0 pound inches, and speeds from 2.5 to 375 revolutions per minute.

The Model 181 actuator incorporates the newest Lear motor of intermittent duty, split-series or single-field type, developed for either reversible or continuous rotation. It has output ratings varying from 0.4 to 15 watts at 24 volts direct current.

Because of the wide variations in applications for these rotary actuators, the maker, Lear, Inc., offers them with or without limit switches, and for multiple positioning. Where very accurate positioning is required, a brake can be provided between the motor and gear box. Also, a magnetic Diskonnect clutch can be supplied for special applications requiring a free running output shaft when the unit is not energized electrically.



Light, compact, high torque

A feature of the Model 181 is an extremely light and compact gear box, so designed that various gear ratios may be obtained with slight adjustments. Four standard gear reductions are available.

The light-weight actuator was developed for such applications as remote valve operation for fuel, oil, and air systems, tuning motors for radios, remote controls, such as operation of camera shutters, doors, and dampers of the butterfly and balanced types, business machines, computers, indexing machines, and so on.

MOISTURE-SET INKS

Are Safe, Rapid Dryers

RAPIDLY coming into use in the printing of wrappers and packages for food, candy, and tobacco is a new type of odorless, non-poisonous, and quick-drying ink.

These new inks must be wet to be dried, and consist of coloring matter held in a resin which is dissolved in a solvent, such as dipropylene or diethylene glycol. When water is added, the coloring matter drops out of solution and is deposited on the paper in a thin, hard film. If the inked paper is sprayed with steam, the ink will dry instantaneously, but the moisture in the air is sufficient to set it in 10 to 20 minutes. The new steam-set inks strengthen the paper instead of weakening it as do many other inks.

Unfortunately, the resins and solvents used in steam-set inks react harmfully with many desirable pigments, but pigment manufacturers are now said to be investigating to determine which of their products can be used.

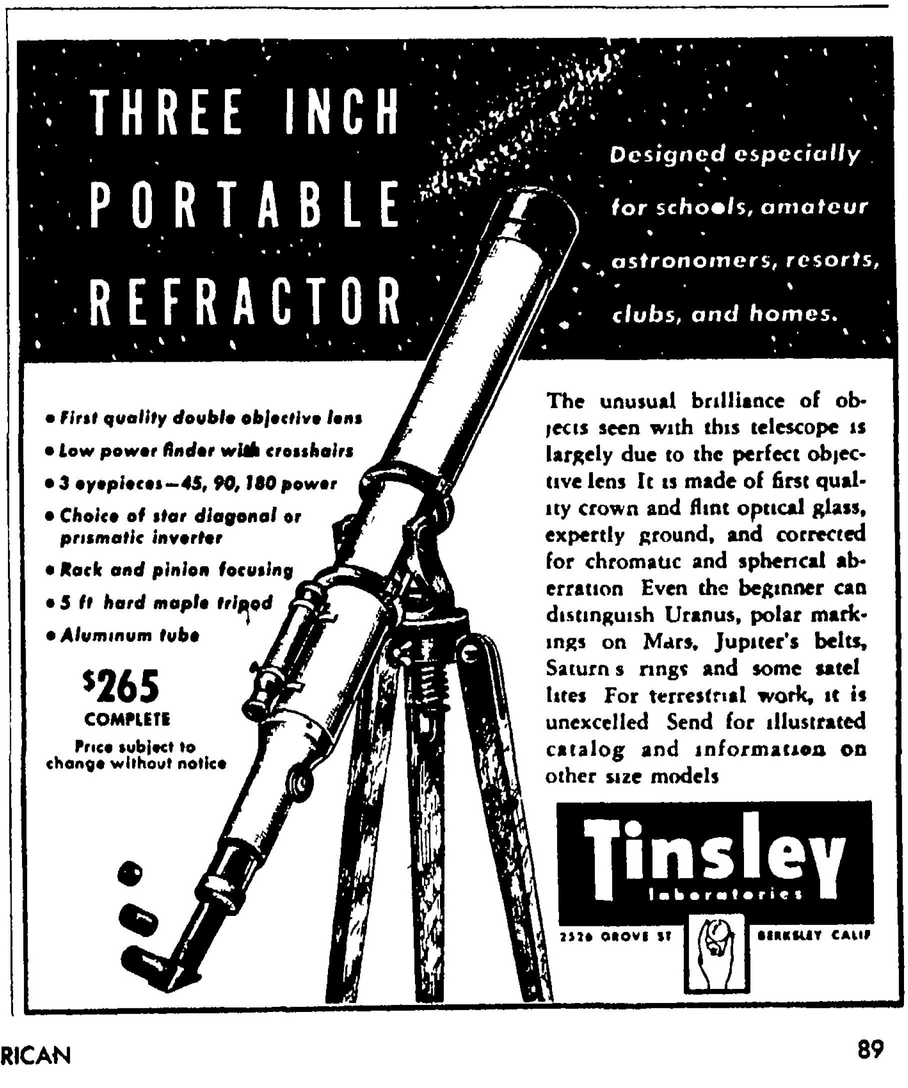
PROTECTIVE PLASTICS

Passes Visible Light, Absorbs Infra-Red and Ultra-Violet

TRANSMITTING only visible light, a plastics material known as Infropake absorbs infra-red and ultra-violet rays. Similar in appearance to many of the regular plastics and available in several colors, it transmits approximately 84 percent visible light with practically no ultra-violet transmission and only about 15 percent infra-red transmission.

Several glass compositions are available which have similar absorbing properties, but it is reported that, with them, the relation of the transmission of visible light to the absorption of infra-red and ultra-violet rays is not as efficient as it is with the new plastics.

The uses for these plastics cover many fields in many lines of endeavor including sport goggles, automobile windshields, and sun visors. In industry, wherever people work in the glare of lighting units that emit infra-red and ultra-violet in sufficient intensity to be harmful, industrial goggles and windows made of Infropake will fur-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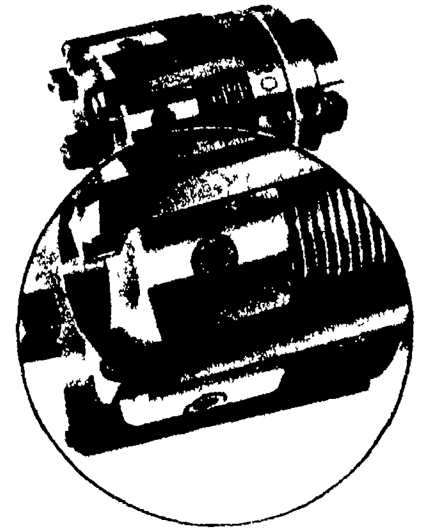

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There Really Is No Mystery About Turbo-Blowers and Rotary Compressors Designed for student training, this 16-page booklet gives complete information on turbo-blowers, rotary compressors and vacuum pumps *Allis-Chalmers Manufacturing Company*, 677, *Milwaukee 1, Wisconsin - Gratis*

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Foreign Trade by Helen R Blank This six-page leaflet deals with the types of employment, prospects, qualifications, preparation and so on in this field Suggestions for further reading are included *Occupational Index, Inc, New York University New York 3, New York —25 cents*

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Have You Considered Overfire Jets for Smoke Abatement?, by William S Major, is a reprint from the magazine "Finish,' which outlines the methods and equipment requirements for effective smoke abatement through use of overfire air jets *Technical Information Service of Bituminous Coal Research Inc 912 Oliver Building, Pittsburgh 22 Pennsylvania —Gratis*

Metco Metallizing Handbook The fourth edition of this pocket-sized handbook, with 86 pages contains recent data on the metallizing process itself—preparation of surfaces, application techniques and finishing—in addition to data on corrosion resistance, specific gravity hardness, bond strength and tensile strength *Metallizing Engineering Company Inc, 38-14 30th Street, Long Island City 1 New York —$2 00*

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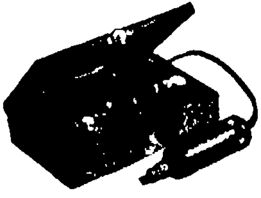

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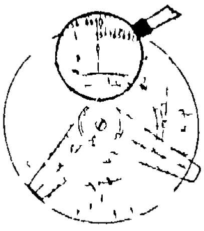

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The Editor

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Edited by H Bennett

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THE NAVY'S AIR WAR: A Mission Completed

Edited by A R Buchanan, Lt U S N R

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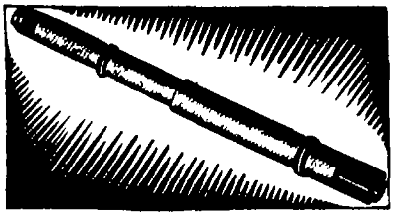

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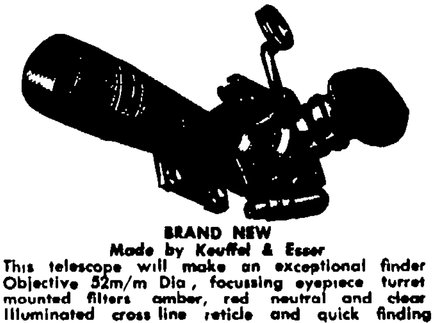

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Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G INGALLS

Editor of the Scientific American books Amateur Telescope Making and 'Amateur Telescope Making—Advanced

FOR THE amateur's first telescope a focal ratio of f/8 is recommended because that ratio is an optimum compromise between the long focus types best suited to study of the planets and other extended objects, such as diffuse nebulae, and the short focus types best suited to galactic star uses The same compromise is recommended because of mirror-making reasons Long or short focus mirrors are no place for the tyro to get first experience, each giving its own peculiar kind of extra headache, mainly having to do with the testing during the work

For second and third telescopes the current style trend is toward the two types mentioned First came the RFT and became well established More recently amateurs have discovered the value of ratios like f/12 or f/15 for the planets Experience of Robert E Smith, D D S, Medico-Dental Building, Sacramento, California with the 5 f 15 shown in Figure 1 at the left compared with the 10" f/8 at the right is of pointed interest He made the 10" f/8 but with it he failed to find the canals of Mars So he wrote Professor Clyde W Tombaugh of the Lowell Observatory for advice and was told this

Perhaps you have not succeeded in getting steady enough atmospheric conditions Under very steady atmospheric conditions, I have seen the main canals around the Solis Lacus with a 5" f/15 reflector at x 150 and with my 12" f/12 I have seen about 15 or 20 canals

Dr Smith, with C A Fogus, respectively president and director of the Sacramento Valley Astronomical Society, set to work to build an f/15 and made it an 8" This gave it a 10' tube but the long-focus mirror wasn't itself so easy "Don't let anyone tell you it is easy to bring a long-focus mirror to a perfect sphere" Dr Smith shouts "The slightest zone in a 'longie' shows up decidedly, owing to magnification, where the same zone in a short focus mirror would not be so noticeable However, Carl E Wells of Roseville, California, an authority on things telescopic, pronounced my mirror OK and its performance proved he was right Not only is planetary detail wonderful but the Orion Nebula is a better sight, while definition on the moon is really out of this world But Mars was too distant and as yet I've seen only the snow cap no canals"

Figure 1 Fogus, f/15, f/8, Smith

Dr Smith gives us the word 'longie" so why not 'shorty' also Longies and shorties

Professor Tombaugh also advised parabolizing the long focus mirrors if as large as 10' in ratios like f/10 or f/12 but suggested that an 8" f/15 might work well if left spherical (Parenthetically, he took the occasion to urge beginners to cold press, saying

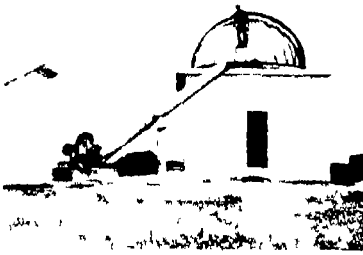
Figure 2 Milwaukee planetary f/15 and its roll off housing

When I learned to do this my zone troubles practically disappeared I always cold press with extra weight—two to three times that of the mirror for at least 15-30 minutes" "A T M" urges this often but the evidence is that many beginners and a few others skip it Cold pressing is basic)

Smith's 8" f/'15 seemed somehow familiar Some other telescope, somewhere Milwaukee! Digging down into one of our numerous towers of papers and files we come up with Figure 2, a telescope built some years ago by the Milwaukee Astronomical Society and it, too, proved, as suspected, to be an 8" f/15 Twin brothers E A Halbach, president of that organization, says this reflector, which they call their planetary telescope gives much better planetary images than the larger (13") f/8 3 within the dome in the background More evidence

This is a good occasion to publish the hitherto unpublished photographs of the unusually well built Milwaukee dome of welded steel construction These show its detail better than many words

Figure 3 shows the one-piece shutter and its simple track extending to the right, a piece of angle iron No complication here

Figure 4 details the solid dome ring of curved steel channel, with one of the rollers and a retainer Again simple, effective Worth copying

Figure 5 shows in the background the framework of the shutter which is in closed position Extending to the left is a single straight length of angle iron acting as the track on which the top of the shutter rolls to one side on the two rollers visible at the top Two bent fingers of iron keep the shutter from lifting off in the wind

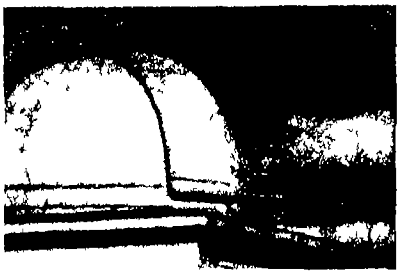
Figure 3 The shutter track

Figure 6 is the bottom corner of the same shutter, with one of the two rolls running on the same angle iron track seen in Figure 3

The whole dome turns easily," Halbach states and a good wind will turn it when the shutter is open and acting as a sail

No blueprints are available None really needed Study the illustrations, sketch up your own proceed to make it

HOUSTON'S BEAM SHIFTER is a simple auxiliary to the knife-edge as commonly used It was devised by Walter Houston, R F D 10 Box 323, Cincinnati 27 Ohio, and its purpose is to provide a kind of slow-motion control to the knife-edge, more delicate than ordinary hand control—not, however, by means of screws

In the photograph (Figure 7) a telescope maker is shown testing a mirror

At left is a housing for the testing lamp The little projection on its right side is a right-angle prism with a slit (or could be a pinhole)

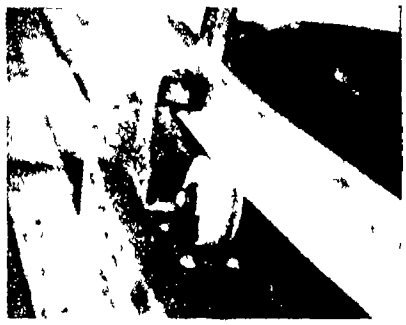
Figure 4 Steel channel dome ring

At right is the tester's hand on the base of the knife-edge

Between the two objects just named is a loose cylindrical disk of wood. Mounted vertically on the top of this disk is a slip of plate glass—say a couple of inches or less in width and 3" or so in height In the half-tone these details do not show clearly but their exact shape does not matter greatly This wood-plus-glass unit may be slid around the table at will Its

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The mirror is set for the familiar Foucault test.

Then the plane-parallel is brought up and slid into the returning cone of rays and is turned so that they strike it perpendicularly

Next, final adjustment of the knife-edge is made and the Foucault shadows are picked up—through the plane-parallel—perpendicularly

Then the knife-edge is withdrawn a little to the user's left so that the mirror will be illuminated all over and is left there

Finally, the plane-parallel is rotated so that the cone of rays no longer strikes it at right angles. Back come the shadows

Here we have a delicate control The underlying principle is simple If a beam of light passes through a plane-parallel at normal incidence, no deviation of the beam will occur (although if it is a converging beam—and in this case it is—it will shorten the focal length about 2/3 of the thickness of the glass but this is a minor effect in this test) If, however, the plane-parallel is *rotated*, so that the beam is no longer normal to its face, it then is shifted slightly—it sidesteps It is offset a little

Figure 5 Shutter top on its track

Normally, in the Foucault test we move the knife-edge into the beam Here we move the beam into a stationary knife-edge

"The rig," Houston reports, "works very well in testing by rolling the shadows to their crests Its sensitivity is amazing, though it requires no delicate movements of the operator I used it in teaching a class of beginners and some of them preferred it to the other method It is the same principle as used in the line-shifter of the Hale spectroheliscope ('A T M' page 196 at bottom) to bring the desired line on the slit Advanced workers and sharks at theoretical optics will probably find in this arrangement an error of a millionth of a wavelength. Basically, the stunt is for helping tyros"

Others may like it, too

WALKDEN'S various richest-field telescopes are designed from formulas based on several fixed fundamentals, as described in "A T.M.A," and one of these fundamentals is, or was, Chapman and Melotte's table of star densities With these density data the richest RFT for refractors proved to be a 2¾" f/6 and for reflectors a 4" f/4 These are the figures in heavy type in the table on page 636 of "A T M.A"

But the Chapman and Melotte tables were for photographic magnitudes and more recent tables by Seares and van Rhijn are for visual magnitudes. This makes a difference in the richest RFT Walkden has recently worked out the new data. The richest RFT for refractors now is a 5" instead of a 2¾" and for reflectors it is a 7" instead of a 4"

Figure 6 Shutter bottom, roller

Better fish out your "A T.M.A" now, while you're reading this, and pencil in some new data

Page 624 column 7, opposite 10, 11, 12, 13, 14, 15, write in 7.85, 21.09, 55 03, 138 2, 334 5, 775 7, respectively Column 8, for same numbers 531, 571, 594, 593, 572, 524

"The new maximum," Walkden writes, "is evidently at about mag 12 4 of column 1, so a 5" instead of a 2½" RRFT is now indicated for column 3

Now, on page 636, interpolate a new column between 6" and 8" reflectors and mark it *the* new reflector RRFT The column 7", 29½", 4.2, x24.5, 0.85", 1.20", 1 61", 0 40", 0 96", 1 07", 0 61", 0 45", 3 50", 1 57", 2.22", 35", 12 7", 107, 225

Next, in same tables, bottom line, change 244, 243, 241, 228, 215, 203, to 206, 217, 223, 224, 223, 221, respectively

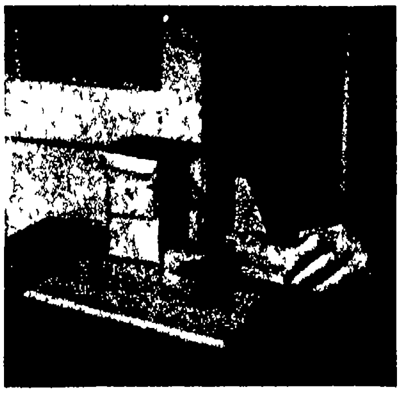

Figure 7 Houston's beam shifter

These small changes will be made in the next printing of "A.T.M.A"

Must you now toss out your present RRFT and commit suicide? A little study of the chapter, such as you probably have already made, will show that the old RRFT isn't so far off the bull's-eye as the above alterations may seem to imply And, if making a new one, a 7" mirror blank will be unobtainable, at least in Pyrex unless you pay (plenty) to have an 8" blank ground down or trepan it yourself However, fairly reasonable ATMs probably would settle for an 8" or a 6" RRFT as a pretty good approximation

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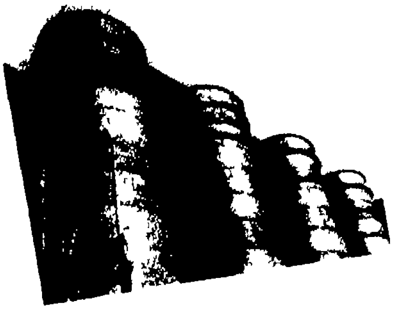

INDUSTRIAL DRAMA This view of part of the aluminum plant of Eletro Quimica Brasileira S/A symbolizes the great growth of Brazilian industry as outlined and pointed up in the article starting on page 100

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50 Years Ago in . . . SCIENTIFIC AMERICAN

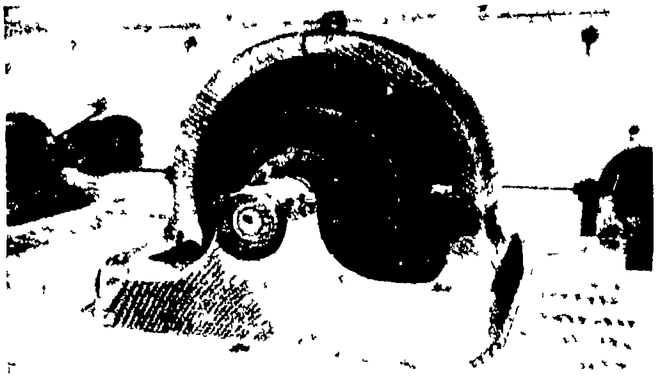
(Condensed from Issues of March 1897)

WIRELESS – "Guglielmo Marconi has demonstrated the superiority of his system of telegraphy without wires Mr Marconi in making use of the Hertzian waves, discovered that impulses set up in his apparatus were able to affect a receiver placed on the further side of a hill Morse signals could be sent with ease through the larger part of a mile of earth and rock He found he had discovered a new form of energy that did not exist in the Hertzian waves The new wave could *penetrate everything and could not be refracted* or bent aside from a straight path No description of Marconi's apparatus has been made public

TRANS SIBERIAN — 'The Siberian Railway is making rapid *progress Sixty-two thousand workmen are employed* Towns are springing up in great numbers along the western section which runs through a 'black earth' country"

POLAR ATTEMPT - The government of Sweden has notified *the Canadian government that Herr Andree will start from* Stockholm about the end of June for Spitzbergen to attempt his balloon voyage to the North Pole

POWER — "One of the latest and, in many respects, one of the most remarkable long distance *transmission plants* is that which has been built by the San Joaquin Electric Company to supply the town of Fresno with light and power Water is taken from these rivers by wooden flumes A pipe line leads from the reservoir down the side of the mountain to the power house a distance of 4,000 feet the total fall being 1,411 feet There are three single jet Pelton wheels for driving the generators, two for driving the exciters and two smaller wheels which operate the governor mechanism The power house contains three 340 K W multipolar General Electric 3-phase generators which deliver current at 700 volts to a low potential switchboard from which it is carried to six 125 K W transformers which deliver 3-phase current at 11,000 volts through a high potential switchboard to the line The San Joaquin Electric Company has established a price of $64 per horse power per year for its electric power The current for lighting purposes is furnished at fifteen cents per K W hour, measured by meter '



One of the 350 K W General Electric generators

PROSPERITY — "Let me ask says Mr Andrew Carnegie in a recent address, under what conditions does the employer of labor make profits and become prosperous? Only when labor is prosperous, *is his reply, and in great demand*, when wages are the highest, and when the demand for his products are the greatest Then, and then only, is the employer prosperous On the other hand, when labor is not fully employed and can be obtained for the lowest wages, when there is little demand for his products, then the employer can never be prosperous"

NIAGARA — "The hydraulic and electrical installations at Niagara Falls were built for the purpose of supplying the new aluminum factory of the Pittsburgh Reduction Company and to supply power to other consumers The company now furnishes power to the Niagara Falls & Lewiston Railroad and the Lewiston & Youngstown Railroad The power house is 180 feet long and is arranged to eventually contain sixteen wheels of about 2,000 horse power each"

DISCHARGE LAMP — "Herr O Schutt, of Jena, describes a new electric discharge phenomenon, which he terms electro capillary light When the discharge of an induction coil is sent through a narrow capillary tube of about 0 05 mm in diameter, provided with aluminum or copper electrodes and filled with air under ordinary pressures an intense luminosity of the thread of air is obtained The narrow capillaries deteriorated rapidly, roughening inside, and were blown into a series of spherical enlargements Wider tubes gave less light but were much more permanent"

GOOD ROADS — 'The growing agitation in favor of building better roads has a deep significance and will have a more widespread effect than is generally supposed for as soon as the people begin to realize that the question is an economic one that vitally affects our national prosperity we may look for a thorough reform in the present methods of road building so far at least as a large number of the States are concerned '

100 Years Ago in SCIENTIFIC AMERICAN

(Condensed from Issues of March 1847)

HOUSING A company with a large capital, is engaged in England in the erection of 1200 houses for the use of the laboring classes, who are to be conveyed back and forth from home to their daily toil by the railway"

MINERALS — "South Missouri abounds in Iron and Copper, in some places Lead is found, Zinc and other metals are also discovered In the northern part of Shannon county, red porphyry abounds—it is very hard, and would admit of a high polish '

PEN MANUFACTURE — "Although millions of metallic pens are consumed in Europe and other parts of the world yet the manufacture of them is little understood, and carried on extensively only in England and the United States"

COTTON FACTORIES — "There are eighteen cotton factories in Georgia It is thought that there is a capital of a million and a half invested in these factories, and that they pay a dividend of from 13 to 24 per cent on this capital"

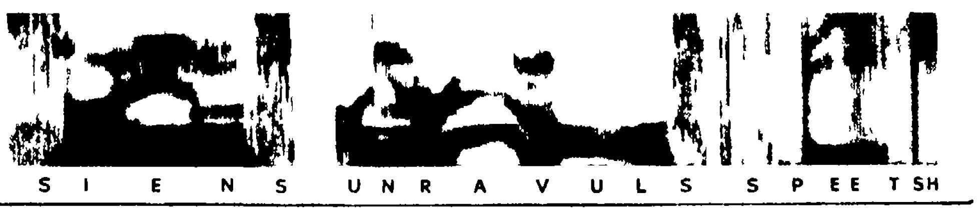
WINDMILLS — 'Master ship builder George Savage, of Bangor, has made some improvements in the mode of constructing windmills, which will, it is said, bring them into general use by mechanics who can apply machine power in their business There is no question as to the feasibility of making use of the windmill in many mechanical pursuits"

Writing with your voice

Years ago Alexander Graham Bell dreamed of a machine that should render visible to the eyes of the deaf the vibrations of the air that affect our ears as sound' He never realized that dream but his researches led to the invention of the telephone

Today Bell Telephone Laboratories have turned the dream into a fact — translating the spoken word into readable pictures

By this new invention of the Laboratories, the talker speaks into a microphone Vibrations of the voice are unraveled through electronic circuits and then are reassembled as luminous patterns which travel across a screen Each syllable of sound has a distinctive shape and intensity



Science unravels speech

Visible speech is still in its infancy, and is not yet available to the public But educators of the deaf are now evaluating it Indications are that the deaf can learn to read the patterns and by comparing the patterns their own voices make with the patterns of correct speech can improve their diction

Patterns of visible speech also provide a means for analyzing and recording sound in the study of phonetics and of languages Eventually visible speech may make possible visual telephony for the deaf

This is but one of many contributions by Bell Telephone Laboratories to the understanding and control of sound

BELL TELEPHONE LABORATORIES *EXPLORING AND INVENTING DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE*

Scientific American
MARCH • 1947

BRAZIL: A Coming Industrial Empire

With an Industrial History Going Back Only a Relatively Few Years, this Huge South American Country Promises to Contribute Greatly to Technological Progress of the World A Survey of Natural Resources, Present Industrial Achievements and the Future

By A P PECK

SOUTH of the equator extending in fact, from north of 'the line' to south of the Tropic of Capricorn—lies a land of tremendous industrial importance, particularly in the fields of metals and all their ramifications Brazil, popularly known for coffee, the samba, and what happens on a rainy night in Rio is these days being called a potential industrial giant, just awakening from an ages-long slumber, and wiggling a few of its fingers to see what will happen And as these figurative fingers wiggle things are happening, and happening rapidly—things that will have both direct and indirect influences on industry in the United States in the immediate future and for the long pull

Depending upon the school of thought involved Brazil is seen as a feared competitor - a cut-throat industrial competitor—of the United States, or as a friendly neighbor who can be depended upon for cheerful co-operation and healthy competition That the latter is the most probable future course is the consensus of those who are in the best positions to trace trends, this opinion is borne out by a survey and analysis of a large segment of the Brazilian metals industry as it stands today

Here are some of the mineral resources which Brazil larger than the United States by the size of Texas, has at her disposal Iron ore in vast quantities and of high grade, rich manganese deposits, nickel, cobalt, chromium, tungsten bauxite, titanium, columbium, tantalite, beryl, from which is produced beryllium, cassiterite, the ore of tin, magnesite, zirconium, mica, quartz, and diamonds With such an impressive list of industrial raw materials as a starting point there is real reason to delve into the question of where

• LOOKING AHEAD •

Brazil as a proving ground for atomic power Vast mineral deposits yet to be discovered and exploited New highways and railroads to be built Hydro-electric power development An expanding market for equipment and experience from North America Aluminum production on a large scale

Brazil is going to fit into world industry of the future

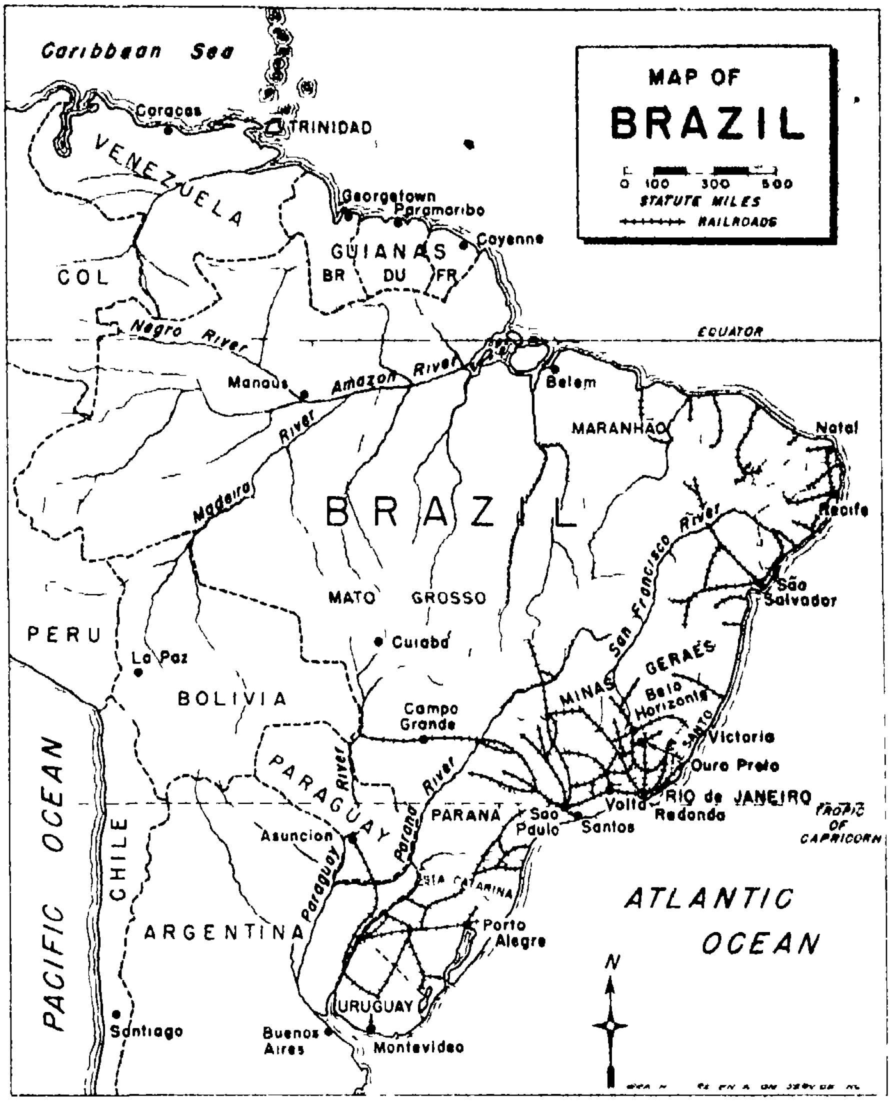
Before getting to facts and figures it is well to give at least a brief glance at the background of Brazil the only South American country where Portuguese is the national language In this way it becomes possible to understand why such a potentially rich nation should have been so long in grasping the possibilities of this industrial age For over three centuries the economic history of Brazil closely paralleled that of our pre-Civil War South The country was virtually ruled by a relatively small number of wealthy plantation owners the rest of the population was composed largely of slaves drawn both from the natives of the country and from the Negroes of Africa

The inevitable result was the perpetuation of a class system in which practically no middle class existed Although slavery was officially abolished in 1888 the system continued to have its effect on the country, which was so widely separated from the growing and expanding technological knowledge of Europe and North America In the meantime, however the beginnings of a middle class started to establish itself in the southern part of the country in São Paulo Settled here were men who were neither landed proprietors nor slaves They had to work for a living, to depend upon their own brawn and brains for their livelihood Small wonder then that in the mild and kindly climate of the São Paulo region is found today the heart of Brazilian industry

Coupled with the slave system to retard Brazilian development was the ease with which the country could be made to produce riches First it was gold, then sugar and rubber and finally coffee and cotton Seemingly all that was necessary was to scratch the surface and there was wealth! Remember cotton in our own South?

When the gold market was lost to Africa, Brazil turned easily to sugar Then Cuba entered the picture and this market was gone But why worry? Rubber could be had for the collecting The Orient changed this So coffee became Brazil's strong point and continued to be until over-production in the late 1920's glutted the market and beans were burned to dispose of the excess Then there was cotton and by 1940 the Brazilian production of cotton exceeded its total value of coffee

All this points up the fact that, under its own system Brazil was able to turn almost painlessly from one to another of its convenient natural resources to roll with the punch, as it were, and to get along with a small part of its population in the wealthy class and most of the rest in dire poverty But things were much different elsewhere The rest of the world was progressing industrially The great middle class of the United States was prospering, taking its own part in building the vast industrial empire of North America And here was another country inhabited by a relatively homogeneous people which had all the natural advantages of the United States but which up to a decade or two ago had failed to take full advantage of them



Present population of Brazil is concentrated along the coast from Belem in the north to the Uraguayan border on the south The map shows specifically those cities and states which are playing most important parts in the present industrial growth of the country Exploration of natural resources is being pushed into the vast interior

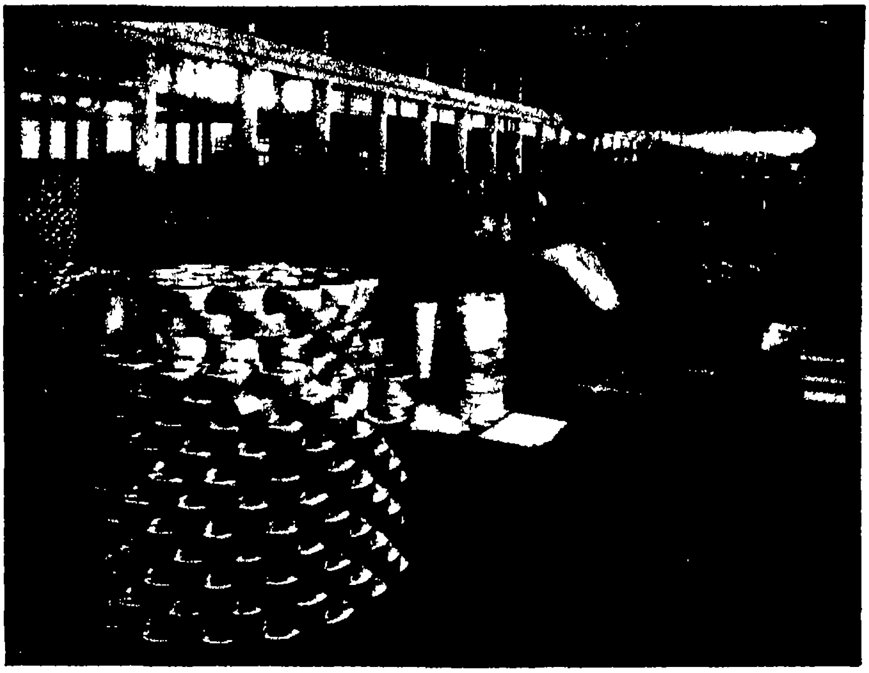
TRANSPORTATION IMPORTANT

So much for the background of Brazilian economics What is going on today is far more important But what is going on today is severely handicapped from the North American standpoint by the lateness with which Brazil has entered the industrial race

Because of this lateness Brazil thus far has a very poorly integrated transportation system Her roads are generally speaking inferior and in many cases are impassable during parts of the year Railroads are short and of different gages that prevent interchange of freight cars Only two railroads extend into the vast central and western interior and much of her transportation is carried on by water—slowly and inefficiently. As a result, much of the economic life of Brazil is localized, as contrasted with the interconnected industrial picture of the United States.

Thus, although Brazil has estimated high-grade iron ore reserves of 15 billion tons, or 22 percent of the world's estimated reserves, transportation and mining facilities are said to hold the key to the reason why Brazil, as late as 1937, was importing almost half a million tons of iron and steel annually; in that same year local production was only 146,000 tons. Link this with the need for coal in iron and steel production and the picture begins to clear. Brazil's proved reserves of coal are low, and those which are available are of poor quality or are so far removed from production centers as to be uneconomical to use.

It is estimated that in the state of Santa Catarina, there are reserves of 500 million tons of minable coal and another three to six million tons in the state of Parana. In both cases transportation of the coal to the point of use is the bottleneck that can be broken only by extensions of railroads or highways or both. It must be remembered, however, that these figures are by no means final; intensive exploration of Brazil's coal and other mineral reserves is only beginning. The Instituto Brasileiro de Geografia e Estatistica (Brazilian Institute of Geography and Statistics) is now in the field, uncovering new indications of existing mineral wealth. Encouraging reports are being received of new coal deposits and of possibilities of new oil reserves as well as of uranium, manganese, tin, nickel, iron, and bauxite.



Partial view of a Brazilian plant producing aluminum utensils

Rolling aluminum foil

IRON AND STEEL — As has been indicated, iron heads the list of Brazilian minerals. And here is one of the cases where the country is doing something to banish an industrial paradox. At Volta Redonda, in the state of Rio de Janeiro, is a steel plant that was started in 1940 and opened in March, 1946. Costing $100,000,000, this plant will have an ultimate capacity of 1,000,000 tons of steel annually (average production of steel in the United States is 100,000,000 tons annually) and will be able to fill practically all Brazilian demands. However, the coal spectre comes in again; unless the fuel picture changes rapidly, Volta Redonda will be operated on imported coal with consequent high cost of production. On the other hand, there is the possibility of using Brazilian coal here, as available, mixed with imported coal as needed to obtain the desired results in certain operations. Then too, there is the opportunity for coal-carrying ships from the United States to Brazil to carry high-grade iron ore on the return trip, thus serving to balance-out the economics of shipping.

To the capacity of Volta Redonda must also be added the capacity of several small steel mills in Minas Geraes which, combined, will contribute an added 200,000 tons annually.

While the United States does not at present (but may in the future) have any real need for iron imported from Brazil, it does need cer-

tain other elements which Brazil has in abundance Most important of all is manganese Manganese ores available in the United States are lean, low in content, and only rich manganese ores are economically suitable for producing ferromanganese Near the iron mines in the western part of Mato Grosso are huge deposits of high-grade manganese ore, estimated at 30 000 000 tons and containing from 45 to 47 percent manganese Here, again however, tapping of this rich and valuable mineral resource is handicapped by problems of transportation Under present conditions the ore is hauled by truck to the Paraguay River and then towed in scows to ocean steamers at the port of Montevideo

ALUMINUM — Although Brazil ranks 12th in world production of bauxite—and its major rich deposits are in open-cut mines which make for easy removal—Brazilian industry has until recently relied entirely upon imported aluminum! This is but another of the paradoxes that drives home the importance of the industrial awakening of the country

"Zipper" production

Major production of bauxite at present is from the rich mines on the Pocos de Caldas plateau in the state of Minas Geraes where the reserves are estimated at 120,000 000 tons But that is not the whole story There are some 80 other known localities where bauxite is to be had in quantity, and the probability that others still remain to be found Most important of those so far explored includes the mines in and near Ouro Preto, where estimated reserves reach 2,000,000 tons, and the Muqui deposits in the state of Espirito Santo, not far from Rio de Janeiro, with estimated reserves of 1,000,000 tons Large deposits of phosphorous bauxite in the state of Maranhao are believed sufficient to fill the domestic need for phosphatic fertilizers with alumina production as a by-product

With these rich sources of bauxite to tap Brazilian enterprise had by 1940, gone only as far as the production of alumina and the exportation of the ore itself Then the first plant for the reduction of aluminum was established by Eletro-Quimica Brasileira S/A, this plant, at Saramenha, in the state of Minas Geraes is now reported to be producing sufficient aluminum for the needs of Brazilian market

Industrial Expansion
in Brazil
(U S Dollars)

1939	750,000,000
1942	1 378,400,000
1945	2 820,850,000

Total figures for industrial production, covering all of Brazilian industry show the tremendous increase which has taken place over a six year period

ELECTRICAL POWER — Closely allied with the production of aluminum, and with many an industrial process and production line, is the problem of power and especially of electrical power Since Brazilian coal deposits and oil reserves have not been fully exploited and imported coal and fuel oil are expensive, Brazilian industry is looking to its rivers as a source of hydroelectric power Here is a vast potential means of reducing aluminum, smelting ores, running railroads building machinery and doing a thousand and one other jobs that have to be done in an industrial economy

A relief map of Brazil shows that many of her rivers which flow directly into the Atlantic or feed such large rivers as the Parana and the Amazon, plunge at times down vast falls that could readily be utilized for power production In fact by 1940 Brazilian hydroelectric plants had an installed capacity of about 1,000 000 kilowatts and were on the increase One of the most ambitious projects designed to level off power production during wet and dry seasons, is that established between Sao Paulo and its ocean port of Santos Here a series of dams has been built to form great lakes extending into the nearby mountains to create what amounts to one huge connected reservoir capable of impounding all of the water that falls during the rainy season This water, released through penstocks for a drop of 2200

Agricultural Expansion
in Brazil

Tons	1920	1940
Cotton	99,701	468,695
Oranges	77 000	1 206,000
Pineapples	18,000	138 678
Bananas	540 000	1 833,334
Coffee	788 488	1,001 813
Cocoa	66 883	128 616
Sugar cane	13 986 000	21 474 591
Potatoes	145 985	464 662
Brazil nuts	6 588	68 162

Industrial expansion in Brazil is not to be had at the expense of its agricultural pursuits as evidenced by this tabulation of increases in production of important Brazilian crops

In an electrolytic zinc plant

feet to the turbines located just above sea level, is utilized to produce power during the entire 12 months of the year.

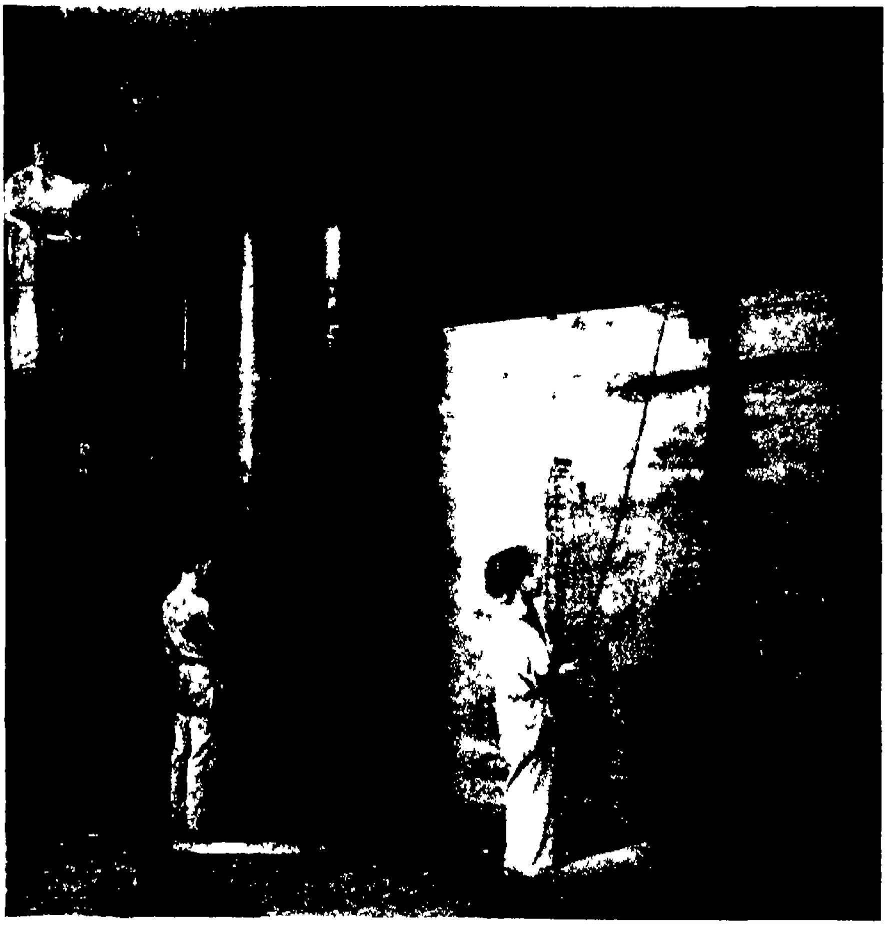
In a similar manner, many of the water courses of Brazil can be developed for power production, our own Tennessee Valley Authority, Boulder Dam, and Grand Coulee have shown what can be done, and Brazil has proved that such lessons can be applied to her own problems. It is now a matter of spreading the application. With the crying need for rail transportation in Brazil, and with the materials available to extend her rail system but not enough coal to power the required locomotives it is not beyond the realm of possibility to visualize hydroelecpower efficiently carried by high-tension lines, as the motivating force of Brazil's future railroads.

Then, too, it should be noted that uranium is listed among the possible new mineral resources thus far reported by the Brazilian Institute of Geography and Statistics. As research in the potentialities of atomic power continues, such supplies of the radioactive element when developed, will become increasingly important. In any event here is a country that can make full use of atomic power supplied by small quantities of easily transported fuel—the great hope and ultimate goal of many workers in this field. Even if Brazilian uranium deposits do not prove out, Brazil should be an ideal proving ground for atomic power as applied to the solution of transportation and industrial power plant problems—of which she has plenty.

SPECIFIC INDUSTRIES — Despite the limitations placed upon it by such matters as great distances, present lack of adequate transportation facilities, inadequate coal supplies and so on, already briefly sketched, Brazilian industry is proceeding apace. To give a perhaps kaleidoscopic picture of what is going on in the metals industry in particular, the following paragraphs are drawn from the writer's notes made during a recent tour of a number of plants in the southern part of Brazil.

Of the nonferrous metals producers and fabricators in Brazil the firm of Laminacão Nacional de Metais S/A is said to do 60 percent of the entire business. This is divided as follows: Aluminum 75 percent, brass and copper 80 percent, zinc, 100 percent (producing 100 tons per month), silver, German silver and so on, 50 percent. Employing some 1500 workers this company is the biggest South American producer of plates, sheets, strips, circles, bars, tubings, extruded shapes and wire of nonferrous metals as well as aluminum and bronze powders for use in paints and printing inks. In 1941 its total production had a sale value of $3,090,523, by 1946 this figure had climbed to $7,780,742 for the first nine months.

A foundry in Brazil



Brazilian workmen shape a boiler plate

Then there is Companhia Brasileira de Artefactos de Metais, with plants in Utinga and São Paulo, manufacturing silver and other tableware as well as aluminum cooking utensils and kitchenware, kerosine lamps, tinned basins, and other metal utensils. In 1941 this company's production of other than aluminum products was valued at $703,600; for 1946 (to October) it had increased to $2,492,245. Aluminumware figures for the same periods are placed at $376,350 and $1,380,250.

Not quite so startling at first glance because they do not extend over such a long period of time are the figures from the slide fastener ("zipper") factory of Companhia Brasileira de Metais. In 1944 this company, operating the largest slide fastener plant in South America, had a sales volume of $912,681; for the first six months of 1946 the figures climbed to $1,226,628.

Aluminum foil production in the only plant of its kind in Brazil, that of Laminacão Caravelas S/A, jumped from $77,656 in 1941 to $434,892 for the first nine months of 1946.

In the plant of Companhia Brasileira do Zinco is produced electrolytic zinc that is entirely consumed by Laminacão Nacional de Metais, with the by-products such as sulfuric acid and copper sulfate sold to other Brazilian industries and to domestic agriculture. Sales volume of this company in 1943 amounted to $47,900; for the first six months of 1946 the volume was $119,599.

These compacted figures give a

(*Please turn to page* 128)

Precision Forgings

By FRED P. PETERS

Editor in Chief, *Materials & Methods*

Born As the Solution to a War Production Problem, the Precision Forging Process Makes Possible Mass-Production of Metal Parts to Precise Dimensions with a Minimum of Machine-Finishing Required

Courtesy Tube Turns Inc

Large precision parts can be mass produced by forging to close tolera

ANOTHER metal-working process has been added to the lengthening list of those which make possible the manufacture of metal parts to very accurate dimensions without subsequent machining. Precision forging is now a reality, and takes its place beside stamping, screw machine work, die casting, impact extrusion, precision casting, and powder metallurgy as an alternative means of mass-producing parts that must be held to close tolerances.

Forging was one of the first metal-working techniques employed by early man, and has always been a leader in industrial importance among production methods. Until recently, however, forgings were never thought of as potentially precision parts. The nature of the process, with the scaling and warping of the forged piece that were attendant on the heating and cooling cycles in forging, were such as to limit commercial dimensional tolerances in forgings to ± 1/16 to 1/32 inch per inch. Tolerances as close as 0.016 inch could be held in special cases, but a fancy premium had to be added to the cost of such parts, and they were far from being mass-production items.

In many cases, however, the outstanding mechanical characteristics of all forgings—great toughness and load-bearing strength—necessitated their use for machinery parts that had to be manufactured to dimensional tolerances as close as 0.005 inch or better. In all such instances the forgings had to be subsequently machined to finished size and shape. Machined forgings are therefore among the most common of precision parts, and are able to compete on a cost basis with all the major metal-forms.

But of the many materials that can be forged, not all of them are also easily machined, and some are not machineable at all. It was this particular situation that led to the development of precision forgings by the Steel Improvement and Forge Company, primarily for the solution of a vital war production problem, but with possibilities far beyond strictly military applications.

• LOOKING AHEAD •
Higher production rates with lower production costs for many precision pieces. Hard-to-machine alloys brought to narrow tolerances easily and quickly. Conservation of materials accomplished by the elimination of much final machining.

FORGINGS REQUIRED—This company, one of the country's largest producers of drop forgings, was called upon early in the war to produce turbine wheels for General Electric turbosuperchargers. Forgings (rather than castings, for example) were required because of the great service stresses involved. The material used (Timken 16 chromium, 25 nickel, 6 molybdenum, balance iron alloy, one of the "super-alloys" developed for high temperature service) was very difficult to machine. But by using a specially developed two-step forging process, Steel Improvement and Forge was able to produce contoured wheel forgings requiring only a minimum of machining and grinding, and to tolerances closer than had ever before been achieved with forgings on a mass-production basis.

In the forging process developed the first operation (blocking) is done at the usual forging temperature for the alloy in question, generally in the neighborhood of 2000 degrees, Fahrenheit. The second or finishing operation is carried out between 1200 and 1350 degrees, Fahrenheit. This "low temperature" operation (some engineers call it "cold forging" to distinguish the practice from forging at temperatures some 700 or 800 degrees higher) not only forms the part to its finished dimensions,

ALLOYS USED IN PRECISION FORGINGS

For Turbine Wheels

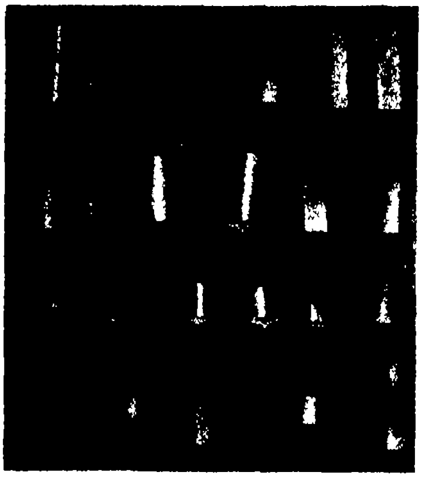
ALLOY DESIGNATION	ALLOY MANUFACTURER	NOMINAL COMPOSITION
16 25 6	Timken Roller Bearing Co	16Cr, 25Ni, 6Mo, Bal Fe
19 9DL	Universal Cyclops Steel	19Cr, 9Ni 1Mo, 1W
N 155	Union Carbide & Carbon	20Cr, 20Ni, 20Co 3Mo 2 5W
S 590	Allegheny Ludlum	20Cr 20Ni, 20Co 4Mo, 4W, 4Cb
Inconel X	International Nickel Co	73Ni, 15Cr, 6Fe, 4 (Ti plus Al plus Cb)

For Blades or Buckets

ALLOY DESIGNATION	ALLOY MANUFACTURER	NOMINAL COMPOSITION
Hastelloy B	Haynes Stellite Co	65Ni, 30Mo, some V
S 816	Allegheny Ludlum	40Co, 20Cr, 20Ni, 5W, 4Mo, 3Cb
N 155	Union Carbide & Carbon	20Cr, 20Ni, 20Co, 3Mo, 2 5W
Inconel X	International Nickel Co	73Ni, 15Cr, 6Fe, 4 (Ti plus Al plus Cb)
16 25 6	Timken Roller Bearing Co	16Cr, 25Ni, 6Mo
K 42 B	Westinghouse Elec Corp	

but cold works it at the same time, thereby greatly increasing its strength and hardness

DIE DESIGN CRITICAL — Both operations are done in large steam drop hammers The success of the process depends heavily on proper design of the first, or blocking die for by correctly designing the first die it is possible to control the amount of cold work that is done in the finishing die and thus to assure uniform hardness across the section of the wheel Improper die design will result in forgings that lack the requisite strength and which vary in cross-section hardness


Courtesy Steel Improvement and Forge Company

The four gas turbine buckets of super alloy in the center of the group and the surrounding stainless steel compressor blades are precision forged

Even more difficult of development and of more potential importance industrially is the production of precision drop forgings in parts as small as turbine blades or buckets Here the problems were infinitely greater Because the blades (especially those for jet engine turbine wheels, as distinct from supercharger turbine blades or compressor blades) must operate at higher temperatures than the wheels, even more refractory alloys are used The best alloys of this type contain large proportions of cobalt and are correspondingly difficult to forge The geometric shape of turbine buckets with their sharply varying thicknesses in the same piece, their necessarily small-radius fillets, and their devilishly difficult contouring has always been one of the most difficult to obtain via the forging process And finally the dimensional tolerances that have to be held are even closer than those required for wheel or rotor forgings Even hand grinding is not feasible because of the practical impossibility of maintaining the delicately designed contours

For example normal tolerances used on turbine blade forgings are about + 0 010, 0 000 inch, while the variation from the true contour of the blade must be held to + 0 005, - 0 000 inch These are so much closer than the forging industry has been accustomed to facing that a wholly new attitude and approach was required for this production job

SPECIAL OPERATIONS — The actual forging of the turbine blades requires a great number of operations Forging temperature is rapidly lost after one to three hammer blows (because of the thinness of the parts) and a series of reheatings must be made as the forging progresses On some parts in the final stages of forging, the metal is so thin that only one blow per heating is possible

And there are many other deviations from the usual forging process that are essential to success For example, die impressions have to be sunk to within 0 002 inch, while unorthodox die materials must be used

Aluminum precision forgings are used primarily for parts subjected to extreme fatigue and impact, or where space limitations do not permit the use of castings

Courtesy Aluminum Company of America

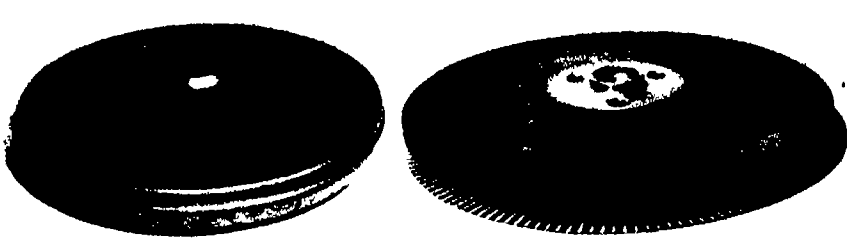
at unconventional hardnesses to minimize die wear and loss of shape Special forging furnaces are required to prevent excessive scaling or decarburizing during the many heatings required on these small parts before they reach finished size, and improved die swabbing compounds are needed to prevent forgings from sticking in the dies It has also been learned that "process grinding" between forging operations proves beneficial

The development of this process of course, originated as the solution of a war problem and has been almost entirely concerned with forgings made of the super-alloys for jet engines and superchargers In addition, the engine manufacturers wished to do as little machining or grinding on the parts as possible, for them the nearest thing to perfection on the part of the blade producers would be none too good This would at first glance seem seriously to limit the breadth of applications of these new techniques and their use in peace-time production

But already the situation is opening up Experience in producing blade forgings in stainless steels has been extensively applied in compressor design and manufacture where the blades need not operate at anything like the severe service conditions required of supercharger and jet engine blades In addition the jet engine and gas turbine manufacturers (custodians of a great peace-time industry in itself) have already relaxed their stringent tolerances on thickness and shape Under these circumstances precision forgings are much cheaper to produce, and part of the resulting saving may be used to machine-finish the blades

This combination of trends makes precision forgings more attractive to the general product manufacturer If costs can be brought down they will be more competitive with castings and machined parts to be made in more common materials than the super-alloys So far, for example, the alloys chiefly used for precision forgings have been those listed in the accompanying table

LOWER COSTS NEEDED — The drop-forging industry's experience with the 12 percent chromium stainless steel for compressor blade forgings is being followed with much interest, for it may well be the forerunner of precision forgings made in lower alloy steels as well as in nonferrous metals If costs can be lowered, the potential field for such forgings is large, innumerable machine parts that must be strong and tough (and therefore are forged), but which have heretofore involved much machining to accurately reproduce final dimensions may in the future be almost entirely forged with only light final machining operations This practice may be especially advantageous when the material is somewhat difficult or expensive to machine



Courtesy Steel Improvement and Forge Company

A precision forged turbine wheel (left) requires very little additional machining The same wheel (right) after finishing, with the blades in place

The Steel Improvement and Forge Company is not the only manufacturer of precision forgings For example the Utica Drop Forge and Tool Corporation and other forging producers took important parts in the precision forged turbo-parts program Indeed much of the work currently being done with press forgings in light metals by a number of manufacturers may be easily classed as precision forging for the tolerances reached approach those achieved in the manufacture of turbo buckets Increasing use of light metals and especially the fast moving developments in forging presses indicate a bright future for precision forged light metals as well

But whether the trend will be toward precision forged light metals or low alloy steels or just to the original super-alloys, the precision-forms field has a new member and engineers another way of making their products

◆ ◆ ◆

ROLLING MAGNESIUM

On Continuous Strip Mill Proves Mass-Production Possible

Most important step in the industrial development of a "young" material is the transition from manual handling to automatic production in its manufacture Steel was long ago introduced to the continuous rolling mill which made possible the low-cost mass-production of sheet strip rails, and rod now so widely used throughout all industry Aluminum too, has recently passed through this same important phase aluminum slabs weighing 2000 to 3000 pounds each now being rolled and coiled on automatic equipment without hand labor

Magnesium may now be ready for this all-important step Very recently the adaptability of magnesium to mass-production methods was demonstrated by rolling some of it on a continuous strip mill designed for steel Cast slabs of Dow FS alloy were put through a reversing breakdown mill with enough speed and power that the magnesium actually became hotter rather than cooler while being rolled from seven inches down to 0 4 inch in two minutes

On the conventional magnesium rolling mill, the 200-pound slabs are expensive to cast and scalp in the first place The small slab is broken down so slowly in the rolling mill and handled so much that it cools off and must be reheated several times On the continuous mill however the magnesium was passed on hot to the tandem mill, came out a moment later as 0 050 inch sheet and was automatically coiled at 1200 feet per minute

CONTACT ALLOYS

Substitute for Precious Metals, May Prove Superior

Faced with shortages of some of the precious metals that have been essential ingredients of high-grade electrical contact alloys for a number of years the Germans during the war developed several satisfactory substitutes that are much cheaper than the originals and which are believed to have interesting potentialities for American electrical-product manufacturers In place of the expensive iridium-platinum combination the Germans successfully used alloys of gold and zirconium, of platinum and beryllium and of tungsten and platinum as overlays or inlays with base metals For example they employed a combination of 95 percent platinum and 5 percent tungsten for ignition and magneto contacts Another useful substitute was an alloy of gold with 3 percent zirconium, which had a hardness of over 300 Brinell

JOB RATING FOR

Through Objective Study, Every Job in a Plant May be Accurately Evaluated. With an Incentive Created, the More Experienced Worker Selects a More Difficult Task Where His Superior Skill and Knowledge Pay Off. The Inevitable Results are Higher Wages for the Worker and, at the Same Time, Larger Profits for the Employer

A SMALL manufacturer of chemicals in the east is having an agreeable surprise. His highly skilled senior employees are demanding the toughest jobs in the plant, and production per man per day is going up, sometimes as much as 100 percent. Pay roll costs are going up too, but not as rapidly as profits.

This plant has both plush jobs on which instruments and automatic controls do most of the work, with the man just standing on watch, and hard ones where liquids must be stirred, powders shoveled, or heavy barrels moved. The dirtier jobs mean hard physical work, soiled clothing, and some exposure to fumes and heat, but they also need plenty of skill and judgment if they are to be run well.

Older and more skilled employees used to take advantage of their seniority rights to get those easiest jobs, the unpleasant tasks on which high skills were most needed being left for the newer men who had learned the least about the plant processes. And the first ambition of every new man was to accumulate seniority and get into line for the softer jobs.

Working Conditions

What happened, on the surface, was that an industrial engineer was consulted and he instituted a job-rating plan. Under this plan, instead of weekly pay being based entirely upon hourly rates which are established by seniority alone, there are also incentives, the tougher the job the higher the incentive. The senior worker still gets a higher hourly base rate than the newcomer, and still can take his choice of jobs in the plant. But if he wants really high pay, if he wants to double his base pay, he has to take one of the harder tasks and run it well.

• LOOKING AHEAD •

More consideration given to what constitutes fair working conditions within the plant. Closer understanding between Labor, Management, and Union. Long-lasting harmony and co-operation among the three.

The chemicals maker expected this incentive system to level out his pay roll somewhat and to solve some of the problems of attracting untrained labor to the plant. But he did not think that it would cause his best men to seek the jobs on which their skills could do the most for his company.

What he had missed was the deepest instinct the American worker has, the desire for a square deal for everybody. The average American worker wants all hands to be treated fairly. "Right Is Right" comes as close to his credo as any words could. Every survey made by any unbiased source finds this to be true. He wants good pay for himself but he thinks it is right and proper that the boss should make a fair profit. He wants to buy at fair prices goods made by men who also received fair pay. He likes sports like baseball and bowling where he can see for himself that the playing and the scoring are fair.

Fixing matters so that the man who licked the toughest job automatically got the highest pay was right in line with this sense of the square deal. It made the best men want to show the others how their skills could pay off.

DRAMATIC FAILURES — Job-rating systems geared to fair pay and incentive rates have had similar effects in so many plants that the rush to adopt them amounts to a boom, a boom that is tempered by

SQUARE DEALING

By EDWIN LAIRD CADY

Courtesy Machlett Laboratories

Supervision Exercised

the fact that the failures of these systems have been as dramatic and bewildering as their successes

One such failure was suffered by a prominent electrical company Here the job-rating system had been ten years in the development So well did the executives like it that they said "Our men will never strike They like our job-rating set up too well The last of these boasts was heard just 24 hours before the men walked out on what was to become the most prolonged and disastrous strike in the company s history

Behind these failures is one of the most exasperating facts in business management A good and fair job-rating system looks like the easiest thing in the world to work out but actually is the hardest It seems as if any high-school boy could handle the simple factors involved but the smartest of executives fail at them In fact almost all good job-rating systems are worked out by consulting engineers It is very rare for an executive to develop one for his own company

Seven simple factors are the bases of nearly all job-rating or 'task evaluation' systems They are

1 Experience
2 Skill and Aptitude
3 Personal Responsibility
4 Physical Effort
5 Working Conditions
6 Supervision Required
7 Supervision Exercised

This list can be expanded and different words can be used to express the same ideas With "aptitude," for example, can go a subhead of "educational requirement," or "personal responsibility" may be called "initiative" But all such lists boil down to just about the same factors

Take that number 5 "working conditions," as an example of the difficulties involved Its interpretation has to vary with nearly every industrial community What a worker in the textile community of Fall River would regard as impossible conditions of heat and fumes would seem mild to his brother in the melting room of a steel mill in Pittsburgh

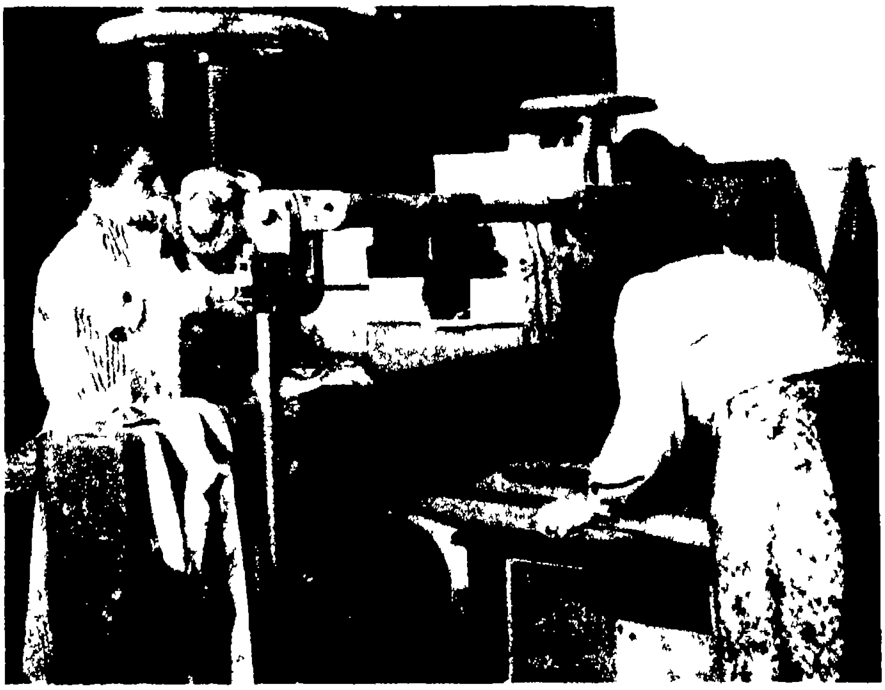
Interpretation of the same term would vary also from plant to plant in the same industry and even in the same community

BAD WORKING CONDITIONS — Two steel stampings and kindred products plants in New England were bothered by bad plant conditions One put in modern wash rooms made sure that all machines were as quiet as practical installed good cafeterias and play rooms, did everything it could to make work conditions pleasant

In the other plant the boss called his men into a meeting "Boys," he said, 'I will buy all of that stuff for you or I will put the cost of it into your pay envelopes It is up to you He had risen from the ranks and many of his workmen had known him when he was a machine operator They knew he would keep his word The great majority voted "down with the luxuries and up with the pay envelope"

Obviously, what would be considered bad working conditions in the first of these plants would be quite acceptable in the second

This problem becomes still more complex when personal opinions are considered The boss has one idea of what constitutes good and bad in



Courtesy Hodgman Rubber Company

Skill and Aptitude

working conditions, the worker a second, and the labor union a third Much depends upon who has done what work in what plant in what other community and is using this previous experience—good or bad—as a measuring stick Much more depends upon whether the boss wants to improve all bad conditions while the worker secretly wants them kept and called bad so he can be paid more for facing them How many ramifications has human nature?

UNBIASED VIEW NEEDED — Amid all this welter of emotions and of subjective opinions somebody has to take a calm detached intelligently skeptical viewpoint The man best able to do this is the industrial engineer who, as a consultant has his reputation for unbiased honesty as his only stake in the business which he is studying

In making a study of this kind the consultant has to dig very deeply First of all he must know the nation-wide working conditions prevailing in the industry he is studying Workers, especially the best workers, tend to migrate to the communities and plants which will offer them the best conditions Gossip of migrants tells all workers where those conditions are He must make sure that the plant he serves will keep as many of its best men as it can

Next he studies the community Some towns contain many "luxury shops with chrome-plated fixtures in the cafeterias with wash rooms and everything else to match Others are "rough shop" towns The worker knows about the shops in which his neighbors work Shops having worse conditions must pay higher wages or require lower skills Otherwise their workers will not believe that they are getting square deals

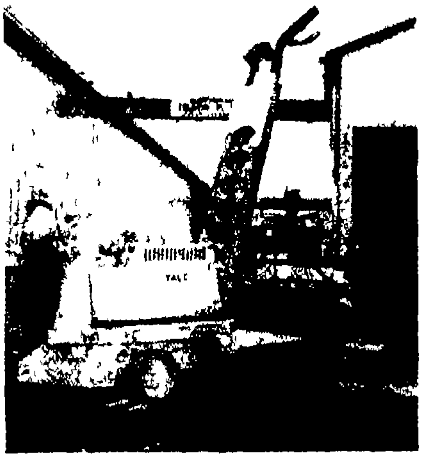
At this point the consultant is ready for his open discussions As early as possible the labor unions are brought into these if any unions figure in the picture

The union leaders almost always are suspicious They usually are told that they need only observe, know what is going on and make sure that management is not hiding any cards up its sleeves But it seldom takes very long for the union men to join discussions in which the welfare of the workers is the topic

The union leaders always like the fact that the job-rating plan will clear the roads for their own future discussions The very emotional and subjective thinking which shows up at the job rating council table is the cause of management-labor conferences spending days on matters which ought to be settled in hours Once the relative values of the various tasks in the plant are established management and labor have a common yard stick with which to measure And when measurements are clear a great many controversies can be avoided

Courtesy Lincoln Electric Company

Supervision Required



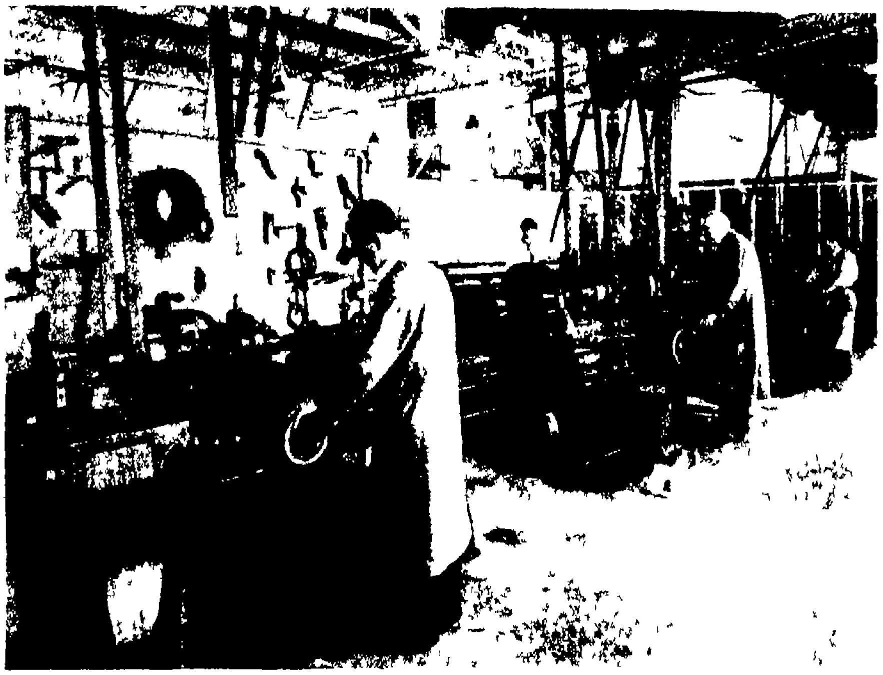
Personal Responsibility

TACTICS VARY — Different consultants use different tactics in the job-rating conferences Many of the best engineers work themselves into positions where they act as impartial arbiters as quickly as they can Their main responsibility is to make sure that everybody assigns the same meanings to the same terms And those meanings are "as used" in that plant or that community What is "personal responsibility for results" in one shop will be "initiative" in another the "exercise of supervision" by a machine shop workman might be called "ability to secure co-operation" in a nearby foundry The important point is that all concerned shall speak the same language in such terminology

Individual tasks in the plant are discussed Everybody at the table has a different opinion as to how the seven factors should be weighed and applied to each job The consultant calmly and impartially finds a middle road—an average of all the opinions

Common sense is important Everybody in the shop knows that the conference is not going to arrive at a different pay rate for every individual task but, rather, that there are going to be grades or levels of jobs and pay rates, and that the levels are going to be averages

Physical Effort



Courtesy Curtis Lighting Inc

Experience

In those averages will be the square deal that the workman wants

Every man also knows that there are jobs on which incentives would be foolish, since the man cannot improve the performance of the machine he runs, and others at which the machine does only what the man makes it do and incentives for his extra efforts are the very essence of the square deal

The engineer works all this out If a job is rated a little above the average for its grade he brings it down a little, if below average, he brings its pay scale up Thus the man with a better job gives a little and the man with a poorer one gets a little more than he would have had And this is the square deal that the American worker likes, that he joins unions and goes on strike to get

When job rating works it gets wonderful results And it works when thought out with the common sense which consists of the unemotional judging of highly emotional situations—of the completely impersonal application of the seven terms which all men find highly personal in their implication

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FLEXIBLE-SHAFT LIFE

Increased Greatly by Stainless-Steel Layer

For rotary brushes, files, screw drivers, and other small tools flexible-shaft drives have long competed with tools directly driven by tiny motors for the same purposes In favor of the flexible shaft has been the small space needed at the work point, and low cost per tool Against it has been a shorter working life than sometimes is economical

Shaft life is now being increased by making them out of two kinds of wire The inner core is piano wire such as has long been used for flexible shafts The outer part is one or more layers of stainless steel, usually type 302

The stainless-steel outer layer has a low coefficient of friction and therefore submits itself to less frictional heat, is able to withstand heat better than is piano wire, and is not likely to be damaged if not kept lubricated while the tool is in storage Formerly the shaft usually wore out when the outer part failed Now the stainless-steel outer part commonly outlasts the core

FRICTION SAWING

Operates on Unknown Bases

The fact that a soft metal or other substance moving at high speed and free to get rid of the heat of friction will cut through a harder substance without itself being worn very rapidly, has been known for centuries Diamonds, the hardest known substances, are cut by soft iron plates with diamond dust as an assistant

Strange to say, nobody yet knows just why this technique works Away back in the Revolutionary War it was known that a soft iron disk cut from a stove pipe could be mounted in a lathe caused to turn at high speed, and then used to cut through a hard file without the soft disk showing any evidence of wear

Modern applications are blossoming everywhere They concern themselves largely with the contour cutting of stainless steels and other hard-to-cut alloys

The band saws used for this purpose are run at speeds up to 20 000 feet per minute and the speeds may go higher The saws can be advanced 128 inches a minute or even more if cutting in a straight line across a quarter-inch thick plate of extremely tough and hard stainless steel or they can make 84 or more inches a minute around the curves when doing contour sawing And the speed of this cutting is more dependent upon the surface speed of the saw blade than upon the thickness of the plate plate thickness makes surprisingly little difference

Actual contact between the saw and the work would wear such blades out in no time, therefore the best guesses are that practically no such contact takes place Somewhere in the experiences being had with these saws are laws of friction which, when worked out may revolutionize some of our applications of bearings and lubricants

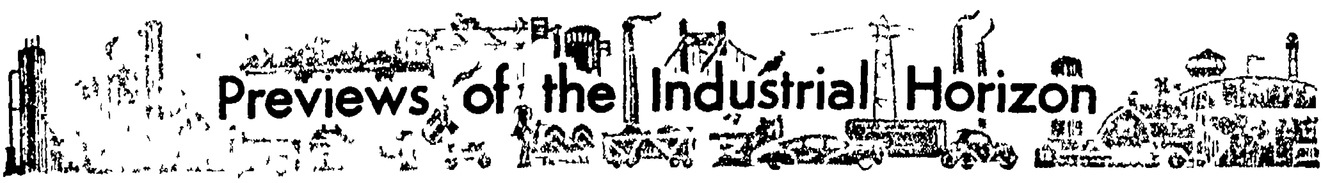
INDUSTRIAL DIAMONDS

Now Selected With Critical Eye to Abilities

A few years ago almost any diamond which was not satisfactory for jewelry could be sold to industry Selection of industrial diamonds was not especially careful For a while their use seemed to be more of a fad than anything else

Ideal conditions for diamond selection

Today the industrial diamond like any other tool, is used right up to the limits of its abilities And the selecting of diamonds for any particular application is a job for the highly-trained expert who uses in his work a powerful magnifying glass plus scientifically focussed, shadow-free fluorescent lights



Previews of the Industrial Horizon

By A. P. Peck

LONGER PIPE LIFE

Plastics-coated steel pipe proved for corrosion-resistance in oil-field work, promises extended life for piping in industrial and domestic uses In oil-well drilling, drill pipe often fails because of corrosion pitting of the inside of the pipe, a thermo-setting plastics covering prevents corrosion and halts the all too familiar corrosion fatigue failures

BUSINESS BY RADIO

Huge industrial plants covering many acres of ground and companies whose plants are far-flung throughout the nation, will find a new means of rapid communication in the radio-linked teletype now on the horizon Through networks involving almost any number of transmitter-receivers it will become possible to relay orders, instructions, changes in production schedules, and the like, without delay and with immediate acknowledgment of receipt

BETTER VISION PAYS OFF

One out of four workers was found to have faulty vision in a recent check of 831 employees in an eastern factory That this condition was largely responsible for plant accidents was shown when, after a visual efficiency program was instituted, there was a sharp drop in accidents and an equally significant decrease in lost work time Many of the workers so examined were fitted with prescription safety goggles

Whether or not occupations involve eye hazards, good eyesight is normally a requisite to good workmanship When management realizes this, it will go far to find a better investment in "production equipment" than installation of a standardized procedure of eye examination and correction

BETTER HOUSE WARMINGS

Those interested in the housing problem—and who isn't these days?—have much to look forward to in the realm of home heating First there will be miniature oil-burning units that take up but a couple of square feet of floor space, yet can heat small and medium-size homes, then there is further development of radiant heating systems, including the "radiant baseboard" and built-in piping types described in these columns many months ago, finally, there is the "heat pump," also not new in principle but just showing its real promise over the horizon The heat pump is a home refrigerator in reverse The refrigerator pulls heat out of food stored within it and dissipates it, the heat pump pulls heat out of the ground, the air, or a convenient water source, and uses it to warm the house (Remember that heat is a relative matter, and the method will become clear) The heat pump will circulate, compress, and decompress a liquid or gas in a heating cycle similar to the cooling cycle in the refrigerator

Coupled with these advances in home heating—many of them can be applied to industrial processes as well—will be new developments in thermostatic and similar controls Notable among these are the types that take recognition of the outdoor temperature to boost or reduce the temperature indoors, with resulting greater uniformity of heat and comfort

THERE'S A LOT IN A NAME

When new materials are pouring from the laboratory, there would be a lot less confusion if many of the synthetics were not linked by name with some already known material, but were made to stand on their own feet Synthetic rubber is a good case in point Synthetic rubbers are *like* rubber but actually are entirely *different* from rubber The same applies to many plastics All too often they are thought of as substitute materials—and hence inferior to materials which they replace

It's about time that a new view was taken of many materials now available to industry Let them prove themselves, take their rightful places in production free from the stigma of "synthetic," "substitute," or "alternate" Above all, let them be used where their properties can be fully exploited, rather than forced for purposes of economy or otherwise to do a job for which they are not fitted

ROLLER-BEARING FREIGHT CARS

A new era in freight cars is seen in the application of roller bearings to 1000 Chesapeake and Ohio freight cars of 70 tons capacity each Although anti-friction bearings have been applied to passenger cars and locomotives, this is the first mass step toward reduction of friction in heavy load-carrying railroad cars It points inexorably toward rail transportation economy through both higher sustained speeds and lower maintenance and hauling costs

STRAWS IN THE WIND

Automotive engineers also are fighting friction, the average passenger car, traveling 50 miles an hour, now requires 21 horsepower for driving the car and another 21 horsepower to overcome internal friction   Hens kept under ultra-violet lamps produce over 10 percent more eggs than without irradiation   Moving fixtures, as well as traveling welding equipment, are being tested on assembly lines involving sheet-metal assembly in a successful attempt to speed-up fabrication processes

WHAT PLASTICS mean to Plywood

All But Unknown Twenty Years Ago, the Plastics-Bonded Plywoods Are Taking Their Place Along Side Conventional Structural Materials, Equalling or Surpassing Them in Strength, Durability, and Beauty

By CHARLES A BRESKIN
Editor *Modern Plastics*

IN THIS day of building-material shortages of all types there is hardly a single material that has not come in for discussion as to its possible usefulness to the construction industry Plastics are no exception

In these discussions there are those who question the extent of the rôle that plastics are prepared to play *now* in the building field They point to the hold-up that certain manufacturers of plastics honeycomb structures have experienced in putting their products into the framework of homes because of local building codes They mention the relatively limited production of some of the new plastics materials as against the staggering need And, finally, they cite the higher initial cost of the plastics materials at this time when set in direct comparison with the traditional building supplies

But there is one thing that many of these doubters forget They forget that the word *plastics* appears more and more frequently as a linkage with the word *plywood* In fact, there are still too many people who have no idea that the two materials are at all related As for any doubt of the rôle that plywood is playing – and will continue to play—in our building program there is the assistance granted the industry by the Government in the shape of a subsidy to obtain more logs from the woods in return for which plywood companies must set aside 50 percent of all production for building

The right of *plastics* to be linked with *plywood* is clearly evidenced by the figures shown in Tables I and II on the relative use of different glues by the softwood and hardwood plywood producers In the case of softwood plywood, approximately 45 percent is made with synthetic resin Only about 41 percent of the hardwood plywood is made with these resins and it is estimated that the demand for the type of hardwood plywood produced with synthetic resins will never amount to more than 60 percent of the total volume This is due to the fact that this type plywood is not used so largely for exterior purposes

The volume of plywood made with synthetic resins is even more impressive when set against the total absence of commercial use of these resins in the plywood industry in the United States as late as 1927 Developments which seem about ready for full-scale production in 1947 suggest that the synthetic resins will continue to grow in importance and will serve to make plywood even more important to the building trades

INCREASES UTILITY — The real value of plastics to plywood lies in the fact that it has made plywood a more satisfactory material for all-round use It has added to the uniformity and quality of plywood and has expanded its usefulness

A case in point is the work now

The flexibility of standard quarter inch plywood is demonstrated by its use in the four concave panels Eighth inch stock was required to construct the sharply curving surface

Courtesy United States Plywood Corporation

With wood metal laminates as used in the table lamp and ceiling fixture, and hardwood plywoods for paneling and furniture interior decorators can achieve effects never before possible being done with the bonding of phenolic resin laminated paper to plywood to give a weather-resistant material that should last for years and prove adaptable to home construction This process would enable the softwood plywood industry to use its imperfect veneer as the outside ply since it would be covered and protected by the phenolic surfacing material This would save the most valuable—the unblemished—veneer sheets for more exacting jobs, and it would also cut down on the waste that is caused today by the industry's inability to utilize the imperfect sheets

Another promising development is the United States Plywood Corporation's Flexwood a thin wood veneer bonded to fabric with synthetic resin glue for use as a wall covering Production was very limited in 1946 due to a lack of fabric for the backing, but it is presumed that this situation will be remedied early in 1947 Other developments of this company with a chance for great expansion in 1947 are Armorply, a plywood bonded to aluminum and Flexmetl, another veneer bonded to metal Both of these metal-combinations give a panel of considerable structural strength and are dependent on the use of synthetic resin adhesives

Another possibility is prefinished plywood to be sold to the customer completely finished in every respect including grooved edges so that panels may be fitted snugly together It may be that such large inventories would be required to keep different finishes in stock that this development will be held up in 1947 But it holds a definite promise for the future

• LOOKING AHEAD •

Greater permanency and more effective weather-proofing for the prefabricated home Simpler, stronger, lighter construction for a great variety of objects from box-cars to gliders More attention to water-resistance and temperature stability Wiser selection of plastics for plywood construction

Belief in plywood as a structural material is evidenced by the action of one large company in building two all-plywood homes in Canada which will meet all kinds of weather conditions and which are expected to be permanent One will have a plywood fir outer surface coated with paint, the other will have an outer surface of varnished birch plywood This company feels that if boats can be made of plywood to withstand constant soaking, a plywood house should be able to take punishment of a similar nature under varying conditions of exposure to moisture heat, and cold

STRONG AND LIGHT — The fundamental advantage of plywood does not necessarily lie in its decorative effect or in the fact that it can be made in large uniform panels It lies rather in the average strength-weight ratio, in the rigidity factor in the minimized variation in directional strength, and in the dimensional stability of the material By using layers of thin selected veneers the non-uniformities of solid wood are minimized so that the average strength-weight ratios are greater than for solid wood This fact is amply confirmed in freight cars constructed from plywood where it is found possible to reduce the dead weight of each car by one ton

In the days when the timber stands in this country were still largely untouched, it was economically possible to produce a wall-board grade of plywood bonded with a cheap non-weather resistant adhesive and sell it into non- or semi-structural markets at a very low cost But with the depletion of both our soft and our hardwoods, the wood became more difficult and more expensive to cut—being located in less accessible sections at considerable distances from the mills If plywood were to be produced at a profit it became essential that it be manufactured to meet the requirements of those wanting structural materials and therefore in a position to pay a better price The economics of the situation also lead to research on composite plywoods and composite laminates The recent announcement of an oak barrel made by gluing white oak veneers inside the more available red oak is an illustration of this trend Another approach is the successful use of Avwood--a composite laminate of mahogany veneers and plastics—in structural work during the war

In the face of this economic situation is was inevitable that the industry should turn more and more to synthetic resins for the improved qualities it sought

TWO TYPES — Softwood is obtained from coniferous trees such as fir, spruce and hemlock, and is the type most generally used for housing It is processed by either the hot or cold press method with various types of glue such as casein soy bean, dried blood, urea, and phenolic When intended for permanent outdoor use it is generally processed with phenolic or urea Moisture-resistant types, of the kind used for concrete forms and various interior jobs may be processed with urea, casein or soy bean glues which sometimes contain dried blood

Hardwood plywood is the type which utilizes wood from deciduous or broad-leaved trees It also may be processed by either the hot or cold press method and, in general, employs all types of adhesives According to census figures, a far greater poundage of urea than of other glues was used during the war years A considerable amount of this

Table I — Softwood Plywood Glue Used for First Three Quarters 1946

Month	Casein	Soy bean	Phenolic	Other glues	Total
Jan	336,000	1 761,000	1,818,000	213,000	4 128,000
Feb	300,000	1,700,000	1,900,000	190,000	4,090,000
Mar	294,000	1,737,000	2,008,000	159,000	4,198,000
April	403 000	1,878 000	2,051,000	158,000	4,490,000
May	519,000	2,010 000	2,390 000	187,000	5,106,000
June	502,000	1,879,000	2,001,000	172 000	4,554,000
July	438,000	1,617,000	1,531,000	145,000	3,731,000
Aug	603 000	2,059,000	2 164,000	148,000	4,974,000
Sept	527,000	2,287,000	2 194 000	185,000	5,193,000
Total	3,922,000	16,928 000	18,057,000	1,557 000	40,464,000

Table II — Glue Used in Hardwood Plywoods*

Year	Casein	Soy bean	Phenolic	Urea	Tapioca	Other glues	Total
1944	1,000,000	10,000,000	5,000,000	18,000,000	9,000,000	9,000,000	52,000,000
1943	1,000,000	10,000,000	6,000,000	16,000,000	12,000,000	9,000,000	54,000,000

* No statistics available for 1945 or 1946

war work was done in furniture plants. This activity necessitated the installation of hot press equipment, a fact that may possibly cause them to switch over to synthetic resin glues in their future work. In the past, starch and animal glues have been more commonly used by the furniture trade, synthetic resins not being particularly necessary.

It is also possible that all West Coast operations will eventually use synthetic resins in nearly all their output since this would make possible the use of the finished plywood either inside or out. At present the cost of synthetic resins is higher than that of other types of glue, an important factor in their industry position.

Among the finished products made from hardwood plywood are boats, gliders, airplanes, cabinets, interior trim, radios, store fixtures, boxes, and baskets.

WHAT RESINS? — In selecting a resin to give the highest quality of finished plywood panel, the first prerequisite is water resistance—resistance over a wide range of temperature to loss of strength in moist conditions. Thoroughly cured phenol-aldehyde, melamine-aldehyde, and urea-aldehyde resins meet the water-resistance test.

A second resin requirement for high-quality plywood is stability over temperature ranges from −40 to +250 degrees, Fahrenheit. By stability is meant not only retention of tensile and impact strength but also resistance to volumetric contraction or expansion.

The third requisite for a resin is that the glue line be free of chemicals injurious to lignocellulose. Acid-catalyzed resins inevitably weaken the wood as time passes. This effect is small in many cases and of no importance in furniture or wall-board panels, but is very bad in structural work. Alkali, however, apparently has little if any harmful effect.

Present glue-line costs run about $2 per 1000 square feet of double glue line for interior type panels, about $3.75 to $4 for moisture resistant concrete-form types, and about $5 for exterior grades. The cost of the exterior glue lines can be reduced appreciably by better mill practice.

It seems safe to predict that during the next few years the volume of resin-glued plywood should more than double. It also seems probable that when the pent-up demands are filled and the markets become competitive, the trend will be more and more to the bonding of all grades of American plywood with resins and that the newer types of wall boards will consume more plastics than ever. Authorities both in and out of the industry believe that plywood potentialities are far greater than presently realized and that 1947 will see a rapid increase in the adoption of new and enlarged applications.

* * *

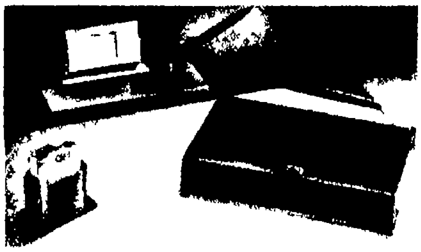
MOTTLED SHEETING

Is Made from Salvaged Plastics

Scrap acrylic, much of which is available from airplane domes and blisters, is being turned into a sheeting called Mottletone, which, approximating the figuration of onyx, can be either formed or fabricated and is available in a wide range of colors.

To produce the sheet, the acrylic scrap is first cleaned in a tumbling apparatus. Then the plastics goes to an air oven where it is heated to a temperature of approximately 250 degrees, Fahrenheit, and sent on to a mixing mill for grinding. The mixture is peeled off the rolls of the mixing mill and placed in an hydraulic press. Under heat and pressure the acrylic flows into semi-positive molds and is cooled. During these processes, dye and plasticizer are added.

The machining, forming, and general care of the resulting Mottletone is much like that of regular sheet acrylic. A jig saw, band saw, or circular saw can be used to cut this sheeting, and saw blades with from six to nine teeth per inch give the best results. Drum sanders have been found the most satisfactory for curved edges, disk sanders for straight edges and belt and vibratory sanders for surfacing. If care is taken not to remove too much material at one time and if the plastics is kept at a low temperature, there is no obstacle to the tapping and threading of this sheet.


Some uses of salvaged plastics scrap

The material should not be used for articles having compound curvatures but it can be easily fashioned into a simple curve. For this forming, the sheet is heated most satisfactorily in an air oven, but the temperature should not exceed 225 degrees, Fahrenheit.

PLEXIGLAS CANOPY

Covers and Protects Convertible's Top

Something different in the way of plastics automobile applications is a full-vision acrylic top for convertibles. The Wright-Austin Company is responsible for this usage and markets the top clear, or in transparent tints of red, green, and blue. Formed from a ¼ inch sheet Plexiglas, there are no seams to obstruct the view, and the top is easily installed, fastening to the body of the car at four points. The Plexitop can be left on permanently, the regular top which it covers and protects being raised or lowered according to the amount of light that is wanted.

PLASTICS MOUNTINGS

Hold Metal Specimens Flat For Laboratory Examination

In metallurgical examination work where a metal specimen is inspected under a microscope, it is important that the metal be perfectly flat over its entire surface, even to the edges. This type of surface cannot, however, be achieved if the test specimen is unmounted.

In looking for a suitable mounting material for their metal testing specimens, M. W. Kellogg Company found that the material they sought had to have the following three qualities: low cost, since the mounting is only a means to an end, not the end itself; ease of use, since the laboratory would not be justified in establishing special equipment or special operators to accomplish the mounting; and availability in color, since each type of metal specimen is mounted in a differently colored material to simplify identification. The answer to all three conditions seemed to be Plaskon urea material.

In mounting specimens the company cuts a small "button" from the metal under test and places it in a cylindrical die. The urea molding powder is then poured around it. Placed in a laboratory press, the assembly is subjected to several thousands pounds pressure and a relatively low temperature until the plastics is cured. Upon removal from the die the metallographer polishes one face of the molded-urea cylinder so that the exposed end of the metal "button" will be flat

METALS PLUS Hydrogen

Produced Commercially Only During the Last Ten Years, the Metal Hydrides are Rapidly Gaining Stature Among Industry's Most Versatile Compounds. Although Their Full Potentialities are Still Uncertain, They Have Already Found Many Applications in Such Varied Roles as a Copious Hydrogen Producer and an Amazingly Effective Drying Agent

By HOWARD C. E. JOHNSON, Ph.D.
Chemical Editor, *Chemical Industries*

• LOOKING AHEAD •
Improved packaging for products subject to corrosion or decay. Many new alloys made possible. Vigorous reducing agents developed, providing many new and otherwise impossible methods for exploitation by *chemists and metallurgists*

METALLIC hydrides have been known to chemists for a long time, but it is only recently that an intensive study of these interesting compounds has revealed their importance from the standpoint of their industrial applications. New uses are being discovered continually and the demand for them is growing. As a result, production of the hydrides is increasing; for example, in a period of 20 months, Metal Hydrides, Inc., made 1,500,000 pounds of calcium hydride alone.

It is often difficult to tell whether the hydrides are fish, flesh, or fowl. Some of them, like the hydrides of sodium, potassium, lithium, and calcium, are true chemical compounds containing a definite ratio of hydrogen to metal. The melting points, densities, appearance, and chemical properties are different from those of the metals themselves. Sodium, for example, is a good conductor of electricity, but when it absorbs sufficient hydrogen it is converted into a crystalline material which is a non-conductor.

But other metals seem to soak up hydrogen as a sponge soaks up water—physically, without chemical change. The hydrogen apparently fills the "holes" between the metal atoms in the crystal structure and is easily "squeezed" out again by heat. The hydrides of titanium and zirconium, for example, look exactly like the pure metals, but they gradually dissociate into hydrogen and the pure metals at temperatures above 350 degrees, Centigrade.

RICH HYDROGEN SOURCES — In fact, all the metallic hydrides decompose upon heating into the metals and extremely pure hydrogen. Some of them, such as calcium hydride, react with water to give twice as much hydrogen as is contained in the metal hydride. The reason for the 100 percent bonus is apparent upon examination of the relatively simple equation for the reaction:

$$CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$$

The reaction is safe and rapid, and the by-product is not corrosive. There is no danger of ignition, for calcium hydride does not inflame when moistened nor does it ignite readily on heating in air to a dull red heat. Precautions must be taken, however, because the heat of reaction with water is very great, calcium hydride is like lime in generating heat when moistened.

Calcium hydride is a very efficient source of hydrogen. A gram of it will produce 1060 cubic centimeters of hydrogen, while a gram of zinc in the familiar reaction with dilute hydrochloric acid, gives only 160 cubic centimeters. For this reason it is widely used to inflate meteorological and antenna-supporting balloons in localities where other sources of hydrogen are inaccessible. Forty pounds of the hydride, easily carried by one man, can generate over 700 cubic feet of hydrogen.

In addition to specialized large-scale uses, laboratory generation of hydrogen is made very convenient by the use of calcium hydride. This application was mentioned in the February 1946 issue of Scientific American.

Under certain conditions calcium hydride is so powerful a reducing agent that it can free the alkali

Gas fired furnaces designed especially for calcium hydride production metals—sodium and potassium—from their salts, and hot calcium hydride will reduce carbon dioxide to methane

IN ALLOYS—This remarkable reducing action is utilized practically to win such metals as titanium and zirconium from their difficulty reducible oxides, and also to reduce mixtures of oxides to metal alloys

The use of a mixture of oxides permits the preparation of alloys where powder metallurgy techniques are ordinarily impossible In attempting to prepare chromium alloys, for example, from mechanical mixtures of metal powders, the chromium particles oxidize and make the mixture difficult to alloy by the usual sintering operation The 100 to 300 mesh powders produced by reduction with calcium hydride are true alloys, on the other hand, and the sintering process is greatly simplified

Pure metals or their hydrides are simply made by heating the metal oxide with calcium hydride in a hydrogen atmosphere, giving the metal (or its hydride) and lime If the metal is the desired product, the mass is cooled in a vacuum, if the hydride is wanted the hydrogen atmosphere is allowed to remain Metals produced in this way are especially good for powder metallurgy, every particle has fused giving discrete spheres which are more stable and have better physical properties than powders prepared by other means

Metal powders now being produced include permanent magnet alloys of titanium and nickel, zirconium hydride for "getters" (residual gas adsorbents) in electronic tubes, a zirconium-magnesium alloy to refine the grain and lessen the corrosion of magnesium, and a titanium-copper alloy used to add titanium to nonferrous alloys for porosity reduction An experimental zirconium-lead alloy promises to be of use in the manufacture of "flints" for cigarette lighters

COATS COPPER — Titanium hydride is used for a novel surface treatment of copper called "titanizing" Titanium has the ability to spread in a thin layer over a copper surface at 900 degrees, Centigrade, like oil over the surface of water It forms a thin coating of titanium-copper eutectic alloy of much greater hardness than copper itself Iron and nickel objects can be similarly "titanized" by first copper-plating and then treating the surface with titanium The process consists of brushing an alcohol or carbon tetrachloride emulsion of titanium hydride on the object to be treated which is preheated to 80 degrees, Centigrade The object is then heated to 950 degrees, Centigrade, for 15 to 30 minutes with enough additional titanium hydride to provide a hydrogen atmosphere, and then cooled Mixture of titanium hydride with titanium carbide titanium nitride or tungsten carbide gives coatings of different properties

Portable hydrogen generator with supply of calcium hydride in small can at left

The value of this process for surface protection is still being evaluated Eventually it may prove to be practicable as a substitute for tinplate

Both titanium and zirconium hold great promise for the manufacture of special alloys Zirconium hardens copper without appreciably lowering the latter's heat and electrical conductivity, indicating its possible use in radiators, switches, and the like Titanium also forms useful alloys with copper, and the pure metal lends itself readily to powder metallurgy for the fabrication of small articles where lightness, high melting point, or corrosion-resistance is desired

Another application of the reducing properties of metal hydrides was described in the November 1946 issue of Scientific American E I du Pont de Nemours and Company announced a process for descaling metals with sodium hydride dissolved in fused sodium hydroxide It is said to be particularly valuable for stainless and other alloy steels Among the advantages cited are these There is no costly loss of metal, no harm can result from over-treatment, no special construction material is required for the tank, no electric current is used, the low working temperature (700 degrees, Fahrenheit) does not harm the metal structure, there is no hydrogen embrittlement, different alloys can be descaled interchangeably, time and space are saved, and disposal of waste is simplified The process is also effective on nickel, cobalt, and copper

SUPER-DRYER — It is claimed that air dried with calcium hydride contains less than 1x10^{-23} milligrams of water per liter of air Phosphorous pentoxide, one of the better common drying agents used in the laboratory, leaves two billion billion times that much water in the same amount of air' The figure given above is equivalent to one molecule of water rattling around in a cube approximately four feet eight inches on a side

Because of its intensive drying action and moderately high capacity for water—seven parts of calcium hydride will absorb six parts of water—calcium hydride is expected to be used widely both in the laboratory and in industry A major advantage is the fact that it reacts at high temperatures as well as at room temperature, in contrast to most of the regenerative types of desiccants, and that the reaction is maintained until the hydride is practically exhausted

A large demand for the hydride is foreseen for drying transformer and vacuum-pump oils as well as for reconditioning dry-cleaning solvents Since the hydride reacts with acids, aldehydes, mercaptans, methyl ketones, and low molecular weight alcohols as well as with water, the drying agent exerts a "sweetening" effect on such liquids Other materials which can be dried by calcium hydride include various hydrocarbon oils ethers amines, chlorinated solvents, paint vehicles plastic monomers such as styrene and vinyl chloride, and (at low temperatures) alcohols, phenols, and esters

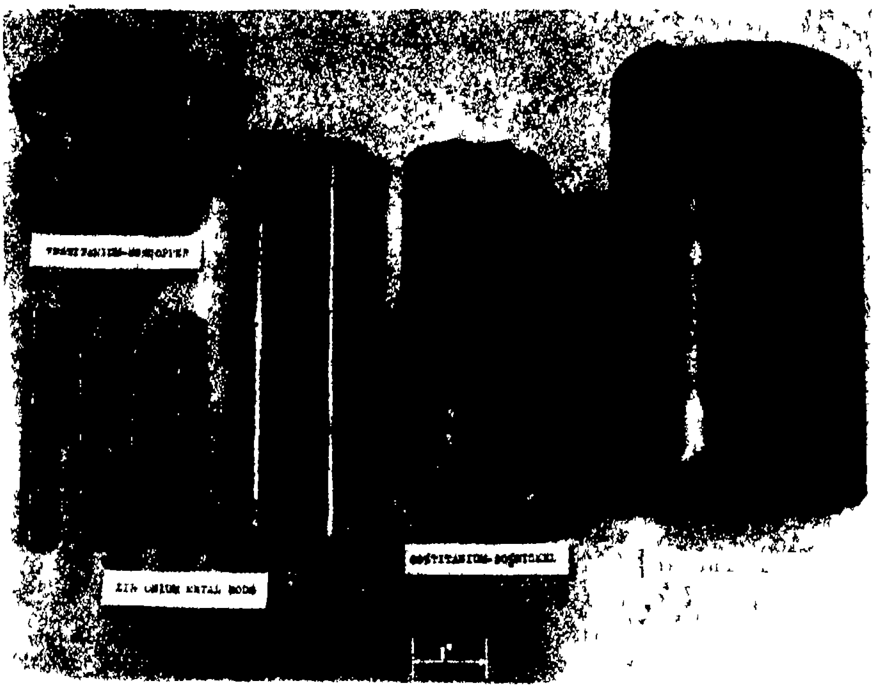
In the packaging field—particularly in packaging pharmaceuticals—calcium hydride may have a potential application, since it is a source of an inert hydrogen atmosphere as well as a dessicant In packaging metal equipment for preservation against atmospheric corrosion calcium hydride will maintain a completely dry atmosphere within a plastics bag or other air-tight wrapping, the small amount of hydrogen formed by reaction with moisture may be desirable since it assures a slight positive pressure within the container

MILD REAGENT—Calcium hydride has advantages over other condensing agents in reactions of the type used to prepare isophorone from acetone or crotonaldehyde from acetaldehyde It is a mild reagent which does not generally cause repetitive condensations with attendant resin formation and it may be used wherever aqueous or alcoholic solutions are to be avoided Moreover, its use prevents significant loss of products through reduction or reversal

Condensation of esters in the acetoacetic ester type of reaction are also promoted by calcium hydride Its use is considered advantageous since no alcohol need be present, and the reactions can be carried out in the absence of solvents or with high-boiling ethers or hydrocarbons These reactions have not been studied intensively, but there are possible advantages in using bivalent calcium derivatives in reactions with dihalides

Other organic reactions of interest take place with calcium hydride Nitrobenzene, for example, is reduced to nitrosobenzene, or even further to azoxybenzene—both of which are useful intermediates in dye chemistry Promising reagents can be made by allowing calcium hydride to react with alcohols Monocalcium ethylene glycolate, for instance, is an excellent condensing agent for the type of reaction described in the preceding paragraph

Among the inorganic chemicals too, metal hydrides do many interesting and unexpected things Potassium fluoride or zinc fluoride, for example, can be reduced to the respective metals by heating to 500 degrees, Centigrade, with calcium hydride, and many other oxides, chlorides, fluorides, and even sulfides may be reduced to the corresponding metals Sulfates can be reduced to sulfides, and this procedure has been used to determine sulfates and sulfur in oils Sulfuric acid is reduced to hydrogen sulfide and sulfur nitric oxide is converted to ammonia, boric oxide and borax are reduced to boron—with the concomitant formation of calcium boride—and silica, glass, and porcelain are partially reduced to silicon Indeed, there are few materials which cannot be reduced by calcium hydride under the proper conditions, although many of the reactions require further study before they can be applied profitably



Several of the alloys made possible by the action of calcium hydride

MADE BY HEATING — Calcium hydride of high purity is made by heating metallic calcium to 400 degrees, Centigrade for 20 minutes in an atmosphere of hydrogen and cooling the resulting product below 200 degrees, Centigrade, before removing The yield is a white, salt-like material The grayish color of the commercial product is due to the presence of small amounts of metal and calcium nitride The calcium for the process is obtained either by electrolysis of calcium chloride or reduction of quicklime with metallic aluminum, the hydrogen by hydrolysis of water

A cheaper way of making impure calcium hydride is to heat quicklime with metallic magnesium in a hydrogen atmosphere The product so obtained consists of 42 percent calcium hydride and the remainder magnesium oxide No way has been found to separate the two components of the mixture

Other metallic hydrides are prepared as described in a preceding section The metal oxide is simply reduced by calcium hydride in the presence of hydrogen

These reactions have been worked out successfully on a commercial scale and in the near future these materials will turn up to do a good job in the metallurgical chemical and allied industries

* * *

FUNGUS ON OPTICS

Prevented by Radio-Active Metal Foil Strips

Fouling of lenses and other optical parts of instruments used in the tropics was until recently a serious problem, particularly in the Pacific areas The way that this blinding "disease" of essential aids to vision was checked by the use of radium has now been revealed Metal foil is treated with radium compounds to give it an effective alpha-ray emission equivalent to about 15 micrograms of radium per square inch and narrow strips of the foil are mounted around the lenses

This method was found effective in preventing the growth of most types of fungi responsible for the blinding effect on lenses up to about three inches in diameter Moreover the treatment requires such tiny total amounts of radium as to be economically feasible and negligible from the standpoint of hazards

Possibly this will provide a valuable application for some of the newly available radio-active materials produced in connection with atomic bomb operations

Electronic Insurance IN THE SHOP

Machine and Tool Jamming, in Addition to Endangering the Operator Can Cause No End of Costly Destruction But by Application of Simple Electronic Circuits, These Mishaps Can Be Virtually Eliminated

By JOHN MARKUS

Associate Editor Electronics

• LOOKING AHEAD •

Lower cost protection for machines and operators An end to self damage of machine tools Hours of needless delay eliminated Less wastage of materials because of malfunctioning equipment

In many automatic punch presses or stamping machines failure to eject the punched-out part before the punch descends for the next stroke is equivalent to suicide for the machine Sometimes if the cavity under the die is large enough quite a few batches of slugs can pile up safely before the crash comes but then there is a real mess and costly dies or punches will need replacement or repairs at the very least

By sensing each ejection of the press electronically with an ingenious arrangement of coils tubes and relays developed by the Norris Stamping and Manufacturing Company any punch press may be shut off the instant before damage is done so the operator on guard can poke out the jammed parts Only a few such safety shutdowns save enough in lost time and repair charges to pay for the entire cost of the electronic protector

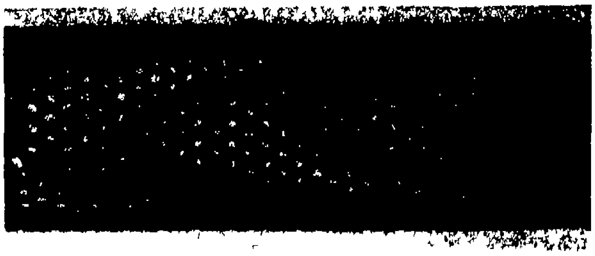
Although the system looks and sounds complex it is actually made up of only two basic units—an amplifier that actuates a relay when a batch of steel slugs slides through the coil which surrounds the ejection chute and an electronic timer that is restarted by the relay each time the slugs come through If the slugs fail to arrive within the predetermined safety interval the timer shuts down the press

Where relatively large articles are being turned out by a huge press even one jam would be disastrous and hence the timer would be set for slightly less than the time for one stroke of the press With large objects only the electronic timer is needed because sensing can here be achieved with a simple snap-action switch that closes each time the ejected part bounces against it on the way out

One example of this nursemaid application of electronics is seen in the manufacture of cylindrical steel cases having almost a thousand holes punched through their walls The punching is accomplished with the aid of an automatic indexing fixture installed in a regular punch press Each stroke of the press punches a row of sixteen holes in the case The fixture is then automatically indexed and the operation repeated until the case has made one complete revolution The small round slugs that are punched out fall into the hollow die where they collect and are blown out in batches with compressed air

SENSING SLUGS— The exit hole in the die was of necessity rather small and sometimes the slugs instead of ejecting when the compressed air was turned on tended to jam in the die cavity After about seven strokes of the press the cavity would be completely filled and then the punches or the die or both would

Ejected slugs fall down shoot at bottom center and pass through the detection coil the only component of the sensing device actually mounted on the press



If not consistently cleared from the press, slugs stamped from this cylinder will cause serious jams

be damaged On less frequent occasions, the compressed air supply failed and the slugs jammed similarly

The solution to this all-too-common industrial problem required, first of all, the devising of some sort of sensing unit that would respond to the presence of the slugs as they were being ejected The coil and funnel arrangement shown in the diagram was therefore contrived to make use of the magnetic properties of the slugs This unit was attached to the press in such a manner that slugs pass into the funnel and through the coil after they are ejected from the die

The coil is connected into a circuit that is normally balanced and carries no voltage, but is unbalanced in the presence of steel A slug passing through the coil thus sets up a small voltage which is built up by a conventional two-tube amplifier

Since compressed air is used to blow the metal slugs from the die, they pass through the sensing coil at a relatively high velocity The circuit is unbalanced for only a fraction of a second, so that an ordinary relay cannot be made to operate satisfactorily on the amplified voltage An electronic relay circuit is therefore used, consisting of a thyratron tube that ionizes or "fires" even on a momentary pulse of voltage, then stays closed or conductive until its power circuit is disconnected by the punch at the beginning of the next cycle of operation The relay in the output circuit of the thyratron stays closed for as long as this tube is conductive, and in this closed position the relay contacts allow the press to keep on running

ELECTRONIC TIMING—It is essential in this application that the press be shut down if the die is not cleared within three strokes after a jam occurs underneath the die This safety shutdown is accomplished with an electronic timer set for a time delay of about four seconds, which is the time required for three strokes of the press The time is controlled by a resistor and capacitor in the grid circuit of a vacuum tube

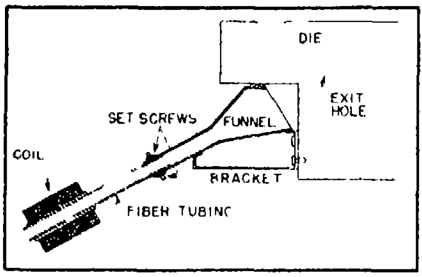
The cycle of the punch press begins with the punch at the top of its stroke and the steel cylinder clamped in position over the die As the punch starts down, a switch operates the solenoid valve that controls the flow of compressed air into the die This blast blows out the steel slugs left in the die from the previous cycle The slugs pass through the sensing coil and induce therein a voltage pulse that fires the thyratron tube and energizes its relay, preventing the electronic timer from starting its count of four seconds On the upward or return stroke the punch trips a switch that opens the thyratron circuit, clearing the decks for another cycle

If no slugs are ejected, however the thyratron does not fire and its relay does not close, so the timer starts If this no-slug situation continues for three full strokes of the press, the timer will complete its cycle and operate a power relay that stops the press

The mechanical construction of any piece of electronic equipment must receive prime consideration if it is to be used in an industrial plant There is usually severe vibration in the vicinity of heavy machinery, especially a punch press of any size Attaching the equipment directly to the machinery should be avoided if vibrations will affect its performance or reliability The electronic units are therefore mounted in a separate cabinet, and are connected together by plugs and flexible cables so that any one of the units can be quickly and easily replaced by an inexperienced technician if it becomes defective

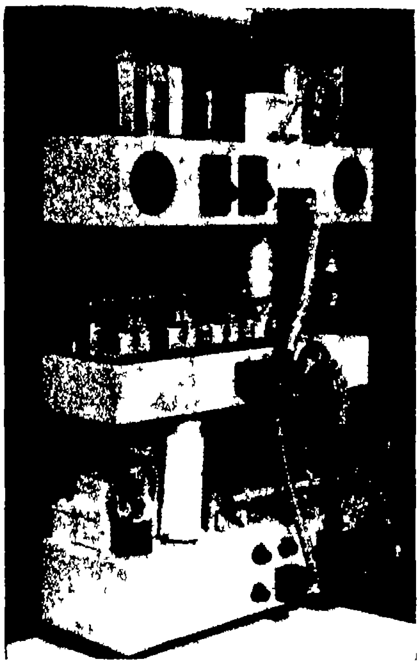
A switch is provided so that when it is closed the press protector has no effect on the operation of the press This is necessary so that the die setters can make adjustments on the press without having it shut off because no steel plugs are being ejected

INCREASED RELIABILITY — This one example illustrates how valuable machine tools can be protected from self-damage by carefully designed and simple electronic controls that do not interfere in any way with efficient operation of the machine Although systems employing elaborate arrangements of light beams have been used for this purpose in the past with a measure of success, they called for mounting



Ejected from the die by compressed air, the slugs pass through a fiber tube and sensing coil (above) The press is automatically stopped if slugs fail to pass through the coil (left) during three successive press cycles of sensitive tubes and optical components right on the press Consequent increased maintenance problems and more frequent failures of the electronic protection equipment soured management in many instances on the feasibility of bringing tubes into the factory itself

The combining of electronics with simple electrical and mechanical units as illustrated here gives practically foolproof protection, however, at both lower initial cost and lower upkeep Electronics thus takes on the role of insurance for owners of machine tools



Removed a safe distance from the vibrations of the stamping press, the electronic brain of the sensing device permits the press to operate as long as the slugs are properly ejected

* * *

AUDIO FILTER

Supresses Static And Needle Scratch

Providing the long-sought suppression of static noise in radio reception and needle scratch or turntable rumble in record reproduction a new electronic circuit has been invented by H H Scott president of the Technology Instrument Corporation In a recent demonstration of the new circuit, records of Caruso's voice sounded like new, even though the records were so badly worn that the characteristic phonograph needle scratch came through with a loud roar when the suppressor was cut out

The principle of operation is based on the fact that a musical program rarely, if ever, occupies the full audio spectrum of approximately 20 to 20,000 cycles at any given instant Rather, at one instant a bass viol might predominate and require a bandwidth of only 40 to 1000 cycles to cover fundamentals and harmonics up to the fourth, and at another instant the piccolo with fundamental notes from 500 cycles to 4000 cycles may be featured For the bass viol, then, the electronic circuit narrows the amplifier bandwidth automatically to the range from 40 to 1000 cycles in which is the desired music at that instant All rumbling sounds below 40 cycles are suppressed, as also are radio static crashes, phonograph needle scratch noise, and other undesired sounds above 1000 cycles However the high-frequency response can be wide open at the next instant for reproducing the harmonics of a high piccolo note or the sound of a Chinese gong Extraneous noise within the frequency range being passed at any instant is scarcely noticed because it is only a small percentage of the total noise and is therefore much weaker in intensity than are the desired sounds

ELECTRONIC EYESIGHT

Allows Blind to Read Letters By Sound Signals

An electronic reading aid that converts the shapes of printed letters into characteristic sounds has been developed so that a blind person may interpret the sounds as letters in much the same manner that a radio operator reads the dot-and-dash code In use, a light beam from a scanning stylus is moved up and down vertically while being moved gradually from left to right along a line of type

In synchronism with the motion of the light spot, the frequency of an audio oscillator is varied from a high pitch at the top of a letter to a low pitch at the bottom The light reflected from the page is picked up by a phototube that operates an amplifier which allows the audio tone to reach the reader's ear only when the spot is on black The frequency then heard tells the reader the vertical position of the black spot A minimum of five complete up-and-down scans of a letter is generally necessary to assure complete identification by tone

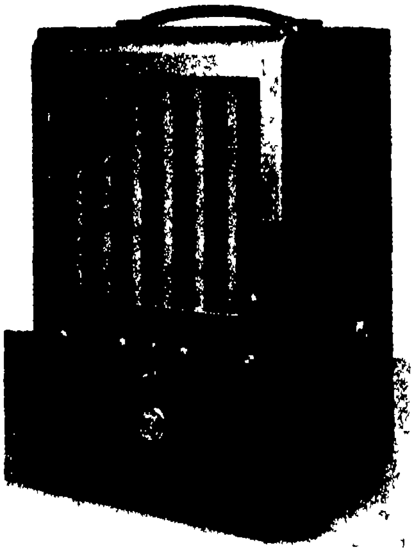
Reading by sound

Before the instrument is perfected and made available commercially, however, many more tests will be made by Radio Corporation of America with substantial numbers of blind subjects under controlled conditions

BLINKING LAMPS

Count Operations by Electronics

The RCA electronic time interval counter used during the war for measuring projectile velocities has been redesigned for peace-time applications It can now count from 1 to 1,000 000 within the breathtakingly short time of one second, with numbered neon lamps flashing on and off to show the progress of counting This means that it can handle any industrial counting job no matter how fast the objects are moving If dials are set beforehand to a desired count, the instrument will automatically start, stop, or shift operations when the predetermined number of items has been counted By this means any process can be controlled on the basis of a preselected figure When that figure is reached, the counter triggers an electrical impulse which stops the operation, shifts the package to another conveyor and starts the counting operation over again



Up to 1,000,000 counts per second

Time intervals longer than one second can be measured by using an external timer to record the number of times the counter repeats its operation

Instrumentation, Measurement, and Control

Papers Presented at the First National Instrument Conference Set the Pace for Profitable Research by All Industry

By ALEXANDER KLEMIN
Aeronautical Consultant, Research Associate
Daniel Guggenheim School of Aeronautics, New York University

MODERN industry calls for ever greater and greater refinement in instrumentation, measurement, and control. Engineers have recognized the needs of the times and accordingly have formed the Instrument Society of America (I.S.A.). Under the joint auspices of the American Society of Mechanical Engineers (Industrial Instruments and Regulators Division) and of the I.S.A., the First National Instrument Conference was recently held in Pittsburgh.

The sessions covered many topics and industries, with dozens of papers presented. Almost all the papers had this in common. They called for greater accuracy and refinement in instrumentation, automatic action or control, and ease of remote indication. There also appeared a new tendency. Consideration is being given to the human limitations of the observer and operator of instrument controls.

How should an engineer deal with the information presented at such a conference? First, by reading intensively certain papers in one's own specialty. Second, by studying abstracts of those papers which may have application to one's own field. Third, by noting what fields of knowledge were covered and in which more information might at some time be sought. Men in industry will find the present article similarly helpful.

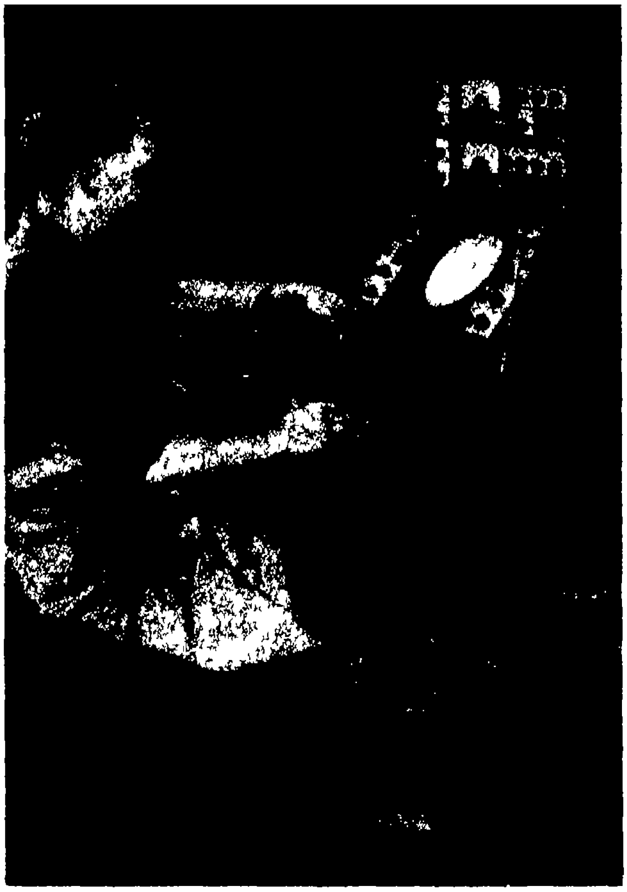
INSTRUMENT PHILOSOPHY—The First National Instrument Conference paper likely to have the widest influence offered more philosophy than technical achievement. Presented by Rear Admiral Luis de Florez of the Navy Office of Research and Inventions, a successful petroleum engineer and personal flier, it emphasized the following points, applicable in all industrial instrumentation:

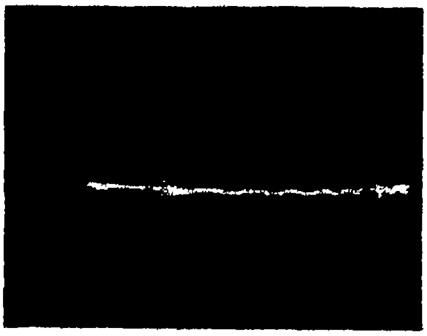
1. Reading of instruments has to be reinterpreted; experience and judgment are required to obtain useful results from any instrument.
2. In response to the demands of industry, instrumentation is so complex that it is hard for a man to utilize the information which pours in on him from a maze of dials. The limit of human powers has been reached in the cockpits of bombers, in the combat information centers of aircraft carriers, in the control rooms of modern cracking plants or solvent separation units.
3. Reliability and accuracy of modern instruments can be taken for granted. Now new ways of presenting information to the operator must be presented so that his senses are not overwhelmed by its volume and diversity.
4. Automatic control is desirable but conditions always arise which make complete automatic control impractical or undesirable.
5. A trend is developing to the use of vertical reading instruments where a number of factors can be compared by a glance at the vertical height of the indicators.
6. By choosing a suitable scale for each instrument, operation will be correct when all vertical readings are on one horizontal line. It will help the operator of a chemical pilot plant if he knows that everything is going well by simply looking for one horizontal line.
7. Because of atomic fission, instruments and controls may be triggered by more subtle forms of energy than heat, pressure, or light. But even such equipment will follow a pattern similar to that of present devices.
8. To meet human limitations, physiological and psychological studies should be undertaken.

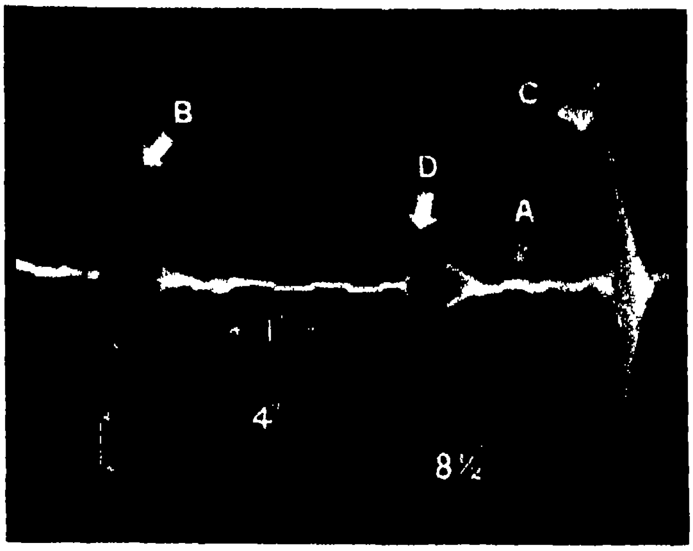
INDUSTRIAL CONTROL — While the Admiral's paper was the most philosophical other papers also took a broad view of industrial control problems. Thus, H. C. Frost, Chemical Division, Corn Products Refining Company, in his paper, "Some Considerations in the Control of Continuous Processes," dealt with specific chemical processes, but the principles he set forth applied to industrial processes generally. The benefits of modern instrumentation can be obtained, said Mr. Frost, only if automatic controls function continuously, information is supplied continuously without lengthy chemical or other analyses, instruments are carefully adapted to the task in hand, controls and instruments are so designed that they bring closer the ideal of a straight pipe line with the raw material introduced at one end and the finished product flowing continuously out of the other end.

How can these desirable objectives best be attained? In the case of the very largest companies a group of specialists may be organized to take charge of instrument and control problems. If a specialist group is impractical, then there must be frank, systematic, and complete co-operation with suppliers. It is important to look at problems both from the users' and the suppliers' viewpoints and to make sure of the type of information which each should have from the other. Finally, technologists should acquaint themselves with the many new and little-known devices which modern progress has brought.

COMPLEX DESIGN—Other speakers agreed also on the desirability of automatic control systems, servomechanisms, and regulators. But







The Reflectoscope sends supersonic waves through the castings (left) A flaw's presence is revealed on oscilloscope screen by pip, D, on trace (lower right) If the piece is not defective, trace (upper right) is undisturbed

• LOOKING AHEAD •

Greater attention to the human factor in industrial controls More emphasis on the philosophy of instrumentation Reduction of mathematical studies to simplified and more widely useful bases

when the automatic system involves many interacting indicators, its design can be very complex To use "feel" alone in design of a complex system involves costly and lengthy experimental set-ups Mathematical studies become unwieldy and cumbersome and sometimes do not give a conclusive result

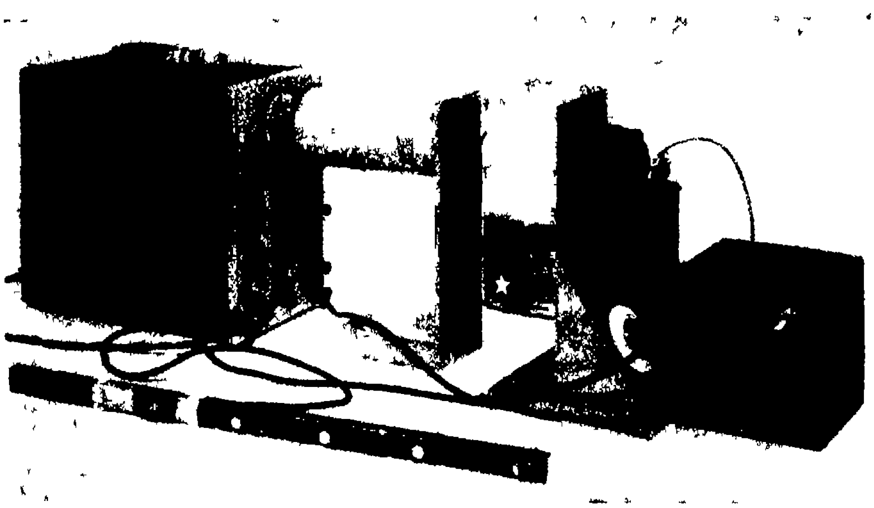
Joel D Peterson of Bendix Aviation Corporation suggested a relatively new method in which mathematics play a subsidiary though important role The mechanism to be controlled and the controller are broken down into their components, represented as boxes or blocks in a diagram Each box has a simple formula, called an "operator," which gives the ratio of the output to input in the box With the aid of these operators, physical ideas are quickly converted into quantitative ones, and the way in which one device interacts with another is visible at all times to the designer End effects are quickly calculated, variations as quickly introduced, and the designer never loses his sense of physical reality A typical application would be in the electrical remote control of the throttle valve on airplane engine Almost any industrial control could be studied by this block method

SUPERSONICS - Not all speakers at the Conference were concerned with the purely philosophical or mathematical aspects of instrumentation Others dealt with ingenious applications of physics As an example, J W Dice of Sperry Products Inc, presented the Supersonic Reflectoscope

"Supersonic" has become a popular word because it defines the speed of airplanes which travel faster than sound Its more prosaic use is in defining short sound waves which have a greater frequency than the sound waves which human ears can hear The Reflectoscope sends vibrations which are supersonic in accord with this definition, through a material under test It measures the time it takes these vibrations to penetrate the material to reflect from the opposite side, or from an internal defect, and to return to the sending point, a pattern on an oscilloscope screen indicates the location of defects

Inside a portable cabinet a generator produces electrical impulses of the order of one-half million to twelve million cycles per second These electrical impulses come out through a television coaxial cable to a quartz crystal scanning unit The quartz crystal has the peculiar ability to expand or contract with application of electrical impulses If 1 million cycle electrical impulse is put back of the quartz crystal scanning unit, a sound beam of one million cycles comes out This beam travels in a straight line, just as a flashlight beam, and is reflected like light The sound goes out and bounces back from any defect in the material under test The same crystal receives the returning sound wave and transfers it into the unit where it is amplified and sent to the oscilloscope screen

There are some tricks to be learned, such as spreading a film of oil over the surface of the material to obtain good supersonic coupling but there is ample reward in quickly obtained information One of the illustrations shows the Reflectogram of a good material The line through the center is the sweep line Each square wave indicates a measure of distance from one inch to two feet At the left is the initial pulse at the surface of the quartz crystal which remains on At the right the sound is reflected from the far side of the test piece Another illustration shows the Reflectogram of a defective material The depth of the defect can be determined by counting the square waves By moving



Picked up by the strain gage, undesirable vibrations may be amplified and then sent to the deflection plates of the cathode ray tube in the oscilloscope

the scanning unit over the surface of the material and watching the oscilloscope screen, it is easy to trace out the pattern of cracks or other defects The operator can scan the interior of a casting as quickly as he can move the crystal over the outside surface The Reflectoscope has been selected for detailed mention as being typical of modern industrial instruments

Other papers presented at the Conference dealt with such topics in inspection and gaging as Surface Roughness Instrumentation and Factory Inspection, Surface Finish Measurement Instrumentation, Recent Trends in Electric Gaging Methods, Training in Inspection and Gaging

INDUSTRIAL PHYSICS — In the light of Mr Dice's paper it is not remarkable that courses in industrial physics are now offered at many colleges H A Leedy, of the Armour Research Foundation, was also dealing with applied physics when he discussed Sound and Vibration Measurements His introductory paragraph is one for all industry to ponder "The subject of the control of sound and vibration is of extreme importance to industry today Unwanted sound or excessive vibration is generally associated with poor workmanship or poor mechanical design Excessive office or factory noise often results in lowered efficiency The consumer is becoming increasingly conscious of noise and vibration and is more critical about these disturbances than ever before It behooves all of us to learn more about methods of controlling these undesirable and frequently unnecessary disturbances"

Since sound is a vibratory motion, the measurement of vibrations includes the measurement of sound The only distinction between the two lies in the effect on hearing Either subsonic vibrations of low frequency, sonic or audible vibrations, and ultrasonic vibrations above the threshold of hearing can be measured The measurement of loudness is difficult because it depends on pitch as well as intensity, and physiology as well as physics has to be considered

Mr Leedy recalls usefully that there are several quantities involved in vibration measurements frequency, displacement, velocity, and acceleration On which of these four quantities should attention be focused? If it is desirable to determine the source of the vibration such as an unbalanced wheel or gear, the frequency is measured, in the design of vibration isolation supports, a knowledge of the frequency of the source is also required If vibratory stresses in machinery are feared as likely to produce failure, amplitude is measured Velocity is of less interest, but if the comfort of passengers in an automobile is to be studied, then acceleration is measured

Because of electronics, vibration instruments are no longer of the bulky "seismic" type where a large mass placed in contact with the vibrating part often changes the vibration Today an electronic vibration instrument consists of a piezoelectric pickup, an electronic amplifier, and a calibrated output meter The pickup consists of a small square crystal rigidly mounted at three corners, the fourth corner being free to vibrate The natural frequency of this crystal is such that the voltage output is proportional to the vibration acceleration By suitable electrical integrating networks, it is possible to measure velocity and amplitude Thus one modern instrument can combine three functions Because the pickup is small and light, it can be mounted anywhere and can give indications at a distance If the crystal pickup is too fragile, the engineer or designer can use a strain gage Because information is so readily obtainable, there is no longer any excuse for unpleasant vibration anywhere

WORTH WHILE—Space considerations will not permit even a listing of the names of all the Conference papers in certain other vital fields which included Controllability of Combustion Processes, Flow Measurement and Control, Automatic Control Terminology, Instrument Research, Measurement and Control, Atomic Energy Research, Instrument Components and Materials, and Naval Ordnance

It will be agreed that the First National Instrument Conference was thoroughly worth while It gave added evidence of the tremendous advances brought about by the war effort, and offered valuable information to every American industry

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ATOM-POWERED CITY

Predicted by Chemist In Ten Years

OPERATIONS of an entire city on atomic power within the next ten years was forecast by Professor Milton Burton of Notre Dame University, former head of the Radiation Chemistry Section of the atomic bomb project at Oak Ridge, Tennessee, at a meeting of the American Chemical Society

"We are not far from the atomic energy power plant of the future," Professor Burton declared "There is every expectation that the first power pile will be operating within two years

"It is reasonable to expect that within the next ten years we shall have a federally subsidized experiment in which a whole city may operate on atomic energy

"Such a municipal atomic energy plant," he continued, "may be used in the future as the principal unit in the city's sanitation system, purifying its water supply, sterilizing its waste, and producing new products at the same time that it generates power

"This development will be made possible by proper application of the vast amounts of radiation energy produced as a by-product by an atomic energy pile," explained Professor Burton "In the atomic piles of the future," he predicted, "provision will be made for use of the radiations in new chemical processes New materials, low-temperature cracking of petroleum oils, and more effective chemical utilization of some natural resources now inefficiently employed are among the benefits to be expected.

"Here we refer to materials like coal, natural gas, and clays," Professor Burton explained. "Studies of the effects of radiation on these materials in contact with various substances to the action of which they are usually inert, may lead to the development of industrially important processes."

PORTABLE INDUCTION PHONE

Permits Constant Communication Between Railroad Men

TRAINMEN inspecting their trains or otherwise working about them can now talk with other members of the crew, the crews of other trains in the area, and with operators of distant wayside control towers, through the use of a recently developed portable telephone. This instrument, the Carryphone, transmits and receives messages through the air, operating in connection with the railroad's inductive telephone system for communication between trains, between trains and control towers, and between the ends of trains.

Complete unit weighs only 29 pounds

Carried by means of a shoulder sling, the new unit weighs 29 pounds and is housed in a cabinet measuring only 16½ by 12¾ by 5 inches. With it, a trainman can leave his cabin car and still maintain constant communication with other members of the crew in the cabin car or on the engine and can talk, as well, with the operators in control towers up to 15 miles distant. He can converse with the operator of another Carryphone, or with the crew of another train, up to three miles distant.

Used by the Pennsylvania Railroad, the new device has proved valuable to crews making train inspections, enabling trainmen to keep in touch with the engineman, and providing a quick means of reporting any unusual circumstance. It is also expected to be valuable to crews of work trains, to track maintenance forces, and to forces patrolling and protecting the railroad.

Essentially a miniature version of the telephone transmission and receiving unit installed on trains, the Carryphone can be compared with a radio "walkie-talkie" except that instead of radio waves it transmits and receives messages through the air by induction, using the track and wayside wires on poles as its communication channels. Thus, its messages are confined entirely to the limits of the railroad, and there is no interference with radio operations in the vicinity.

In using the Carryphone, trainmen need only lift the hand piece to place the unit in operation. Tiny storage batteries provide power for approximately two hours of continuous service. When not in use, the Carryphone rests in a receptacle in the cabin car, which automatically connects its batteries, for charging with the larger batteries of the car's train telephone unit. Lifted from the receptacle, it is ready for immediate use.

AUTO VENTILATING

Systems Provide Even Heat With No Drafts

ALREADY applied on aircraft, two methods of heating and ventilating new to the automotive industry are under consideration in Detroit. Both systems are said to keep the atmosphere within a car at approximately 70 degrees, Fahrenheit, to hold humidity at reasonably constant levels, to eliminate drafts, to prevent windshields and windows from fogging and even to protect allergy-prone passengers from pollen by filtering incoming air. With one system, air enters an intake scoop, passes through filter and heater, flows through the side panels, warms the interior by radiation and convection, and leaves through floor vents. In the second system, a heater mounted at the rear of the car forces air from vents downward over the windows and out through floor vents. It is said that these concepts of weatherproofing automobiles while admittedly theoretical, still are sufficiently practical to invite an early start on developmental work.

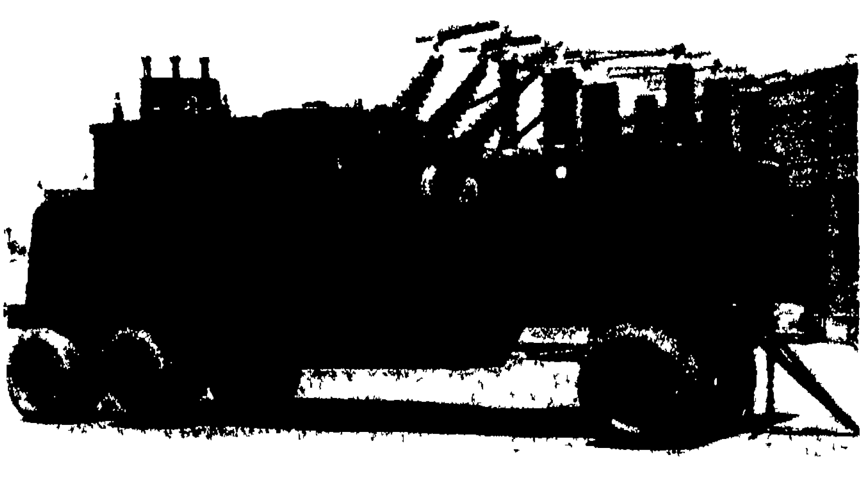
MOBILE SUBSTATION

Compact Emergency Unit for Domestic Utilities

FIFTEEN mobile unit substations—every one for a domestic utility—are now under construction by the General Electric Company. This apparatus is recognized as essential equipment on modern electric systems not only for emergency service but equally for use during maintenance or rebuilding of regular substations, system changeovers, relieving seasonal overloads, or supplying the power requirements of temporary loads.

Typical of the 15 units now under construction is the 2500 kilo-volt-ampere unit for Ohio Power Company, which General Electric engineers state is representative of the type that has more or less set the standards for future mobile unit substation designs. The 22-ton unit is low-slung and streamlined, a style which not only presents a pleasing appearance, but also serves to reduce cleaning upkeep and provides a definite safety factor by shielding operators from high voltages. Only necessary bushings and certain operating parts are exposed. All other apparatus is concealed behind the panels.

The unit has an over-all length



Standards set for future mobile substations of 25 feet and a width of 8 feet, which is within the maximum dimensions permitted by the highway laws of most states

WEED-KILLING SPRAY

May Be Safe for Corn If Used Carefully

TESTS with the weed-killer known as 2,4-D as a spray to weed corn have given satisfactory results against certain weeds with little or no injury to young corn plants in preliminary trials at the New York Agricultural Experiment Station at Geneva Using the 2,4-D at a concentration of 1000 parts per million tests were made with corn eight to ten inches high and in plantings where the tassels were just beginning to show In those fields where an effort was made to direct the spray away from the upper part of the corn plants, very little, if any, injury of the corn was observed However, where the spray was intentionally applied to the top of the corn, severe injury resulted

REMOTE VIEWER

Represents Television's Entry into Industry

PROVING itself practical in its first industrial application, a device embodying the basic principles of television permits close observation of dials and indicators, or even of an entire process, where it would be otherwise impossible due to inaccessibility or danger to an observer

This device, the Utiliscope, has been in operation for several months at Consolidated Edison's Hell Gate Station Power Plant in New York where it is used to show the water level in a boiler remotely located from the main control room A photo-electric camera which is focused on the water-level gage continuously transmits the picture to a control panel where the image is reproduced on a screen similar to that of a home television receiver This permits observers in the control room to keep a constant check on the boiler 325 feet away Not only are the boiler and main control room separated by a distance greater than an average city block, but also by eight floors, a building wall, and various other obstructions

The use of the Utiliscope in large power plants such as the Hell Gate Station is only one of numerous applications for which it is suitable It is expected to be valuable in the conducting of dangerous research where it would permit close viewing of the progress of experiments from a safe distance, and observing processes involving radioactive substances in atomic power plants It is said also to be ideal for use in observing such operations as the coal feed to pulverizers or stokers, the presence of smoke in stacks, conditions within steel furnaces, the inside of oil wells, the condition of pipelines and their pressure pumps temperature gages in large warehouses, especially those involving refrigeration, and readings on electric meters at remote points

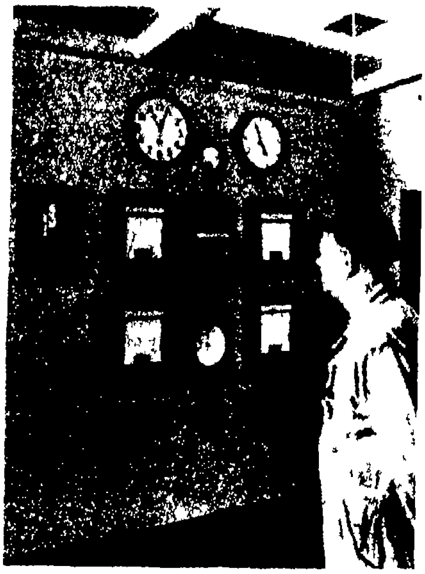
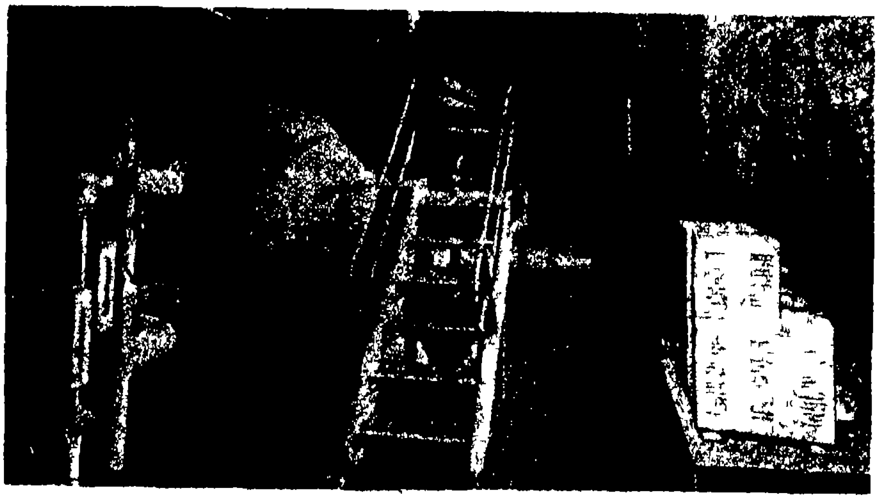


Photo-electric camera focused on gages in boiler room (below) sends a continuous picture to indicator at extreme left of control panel (above)



The Utiliscope, developed jointly by the Farnsworth Television and Radio Corporation and the Diamond Power Specialty Corporation, is compact as well as simple in construction The complete installation, which weighs only 121 pounds, includes four units—camera with deflection unit, two small power units, and the monitor or viewer It has fewer tubes than a good radio set, and except for the camera pickup tube—the Farnsworth Image Dissector—all its electronic tubes are standard types easily available

OVERLOAD CLUTCH

Disengages Rotating Elements By Introduction of Lubricant

EQUIPPED with a novel means for overload disengagement, a new type clutch is intended for use where a problem of overloads in the transfer of torque exists

The new device, called the Wolff clutch, is said to be suited for installation in automobile transmissions to make the shifting of gears entirely automatic, as a safety release in the propeller shaft of a motorboat, as a devise for controlling torque in power driven tools such as screw drivers and tapping machines, as a safety coupling in printing presses, and in other types of automatic machinery

The clutch brings about complete disengagement of two connected rotary machine parts through the automatic introduction of a lubricant between the frictional surfaces as soon as one of the parts is overloaded In one form, the Wolff clutch consists of a cylindrical shell attached to a hub, multiple shoes mounted on another hub in such a way that they bear against the internal cylindrical surface of the shell a means for controlling the pressure between the shoes and the shell, and a lubricant within the shell This arrangement encourages the formation of a separate fluid layer whenever overloading occurs Torque may be transmitted from either hub and in either direction of rotation

The torque is transmitted by the static friction between the shoes and the shell When the transmitted torque becomes excessive, slippage occurs Since the shoes are free to tilt slightly a film of lubricant is formed between the shoes and the shell, resulting in substantially complete disengagement of the clutch As long as there is relative motion between the shoes and the shell, the fluid film is maintained and the clutch remains disengaged. The instant that the relative motion ceases, the film is broken and the clutch is re-engaged. Thus the clutch may be re-engaged by bringing both shafts to rest or to the same speed. The disengaging torque may be controlled by the pressure loading on the shoes.

In one application of the clutch to a flexible coupling the shoes are molded into a rubber-like core which, after being fitted within the shell, is put in compression by spring loading, thus expanding the shoes against the shell. The core is made of the rubber-like material because it has the ability to adapt its shape to the formation of a fluid film. Also, it can damp out torsional vibrations and can compensate for misalinement.

The Wolff clutch can be applied to an automatic gear-changing mechanism. Here, it is arranged to take the place of the sliding-jaw clutch in a conventional transmission. An over-running clutch is mounted on the countershaft. On starting, the load is carried through the over-running clutch and gears because the automatic-clutch shoes are so lightly loaded at low speeds that they will not transmit torque. When the load is up to speed a momentary deceleration of the driving shaft to the speed of the driven shaft will engage the clutch. The drive is now direct but if the load becomes excessive the Wolff clutch disengages and the gear train again picks up the load.

PLANES ON FARMS

Predicted as Major Factor in Rural Life

According to Edward A. O'Neal, President of the American Farm Bureau Federation, "the advent of the low-cost, safe, and easily flown plane means a lot to farm and ranch people. Farm boys, most of whom are mechanically minded to a notable degree, take to air travel as a duck takes to water. Planes are now in use for dusting, seeding, range patrol, coyote hunting, and many other uses. Plane transportation of high-quality, perishable foods offers some interesting possibilities. It's my guess that 10 years from now farmers will be using air transportation to a degree that few people envision today."

CONCRETE PROTECTION

Afforded by Capping With Wrought-Iron Channels

Channels are slipped into place, caulked, and secured by expansion bolts

The extended lower edge of cover fits beneath the underside of the spandrel

Installing protective covers, fabricated of wrought iron plate, over spalled concrete spandrels is the latest technique devised for this type of building maintenance. A consulting engineer theorized that such an installation would be more feasible than to attempt repair of concrete spandrels between the columns of an eight-story building. The spandrels were severely spalled by atmospheric attack and in need of immediate attention. Recalling how wrought iron plates are installed on submerged concrete piers and similar structural members which are subject to damage from water and ice, the engineer designed "channels' of 3/16 inch wrought iron plate to cover the building spandrels. Mortar was chipped out over each spandrel to a depth of 1½ inches and the channels were slipped into place, being well caulked with a high grade mastic and secured by expansion bolts.

Besides improving the exterior appearance of the building, this type of maintenance construction provides additional structural strength, according to the installing contractor. Since the standard maximum width to which wrought iron plates are rolled is less than 18 feet, 6 inches—the length of the spandrels—it was agreed that the channels should be fabricated of four lengths of 3/16 inch plate, each 55-1/2 inches in length, welded together. The channels were cold bent so that the lower leg was 4 1/2 inches wide, forming the underside. The top leg, fitting over the top of the spandrel, was 1 3/4 inches wide while the channel web was about 9 1/4 inches deep.

POWDERED-COAL LOCOMOTIVE

Now Starting Construction, Promises Economy and Efficiency

Some idea of how the first American gas-turbine locomotives ("Powdered Coal Feeds A Turbine" Scientific American, August 1946) will be built has now been revealed. Bituminous Coal Research, Inc., recently accepted an Allis-Chalmers contract for a gas-turbine power unit designed to run on powdered coal. The former organization's Locomotive Development Committee, representing railroad and coal companies co-operating in a project to build a better coal-burning locomotive, expects to have the new type locomotive on rails within two years.

Supporting predictions for high

efficiency, low operating cost, and easy maintenance will be several specific advantages inherent in the locomotive's power generating equipment The 3750-horsepower gas turbine is to be a packaged unit, with a single base common to all parts—the gas turbine, its axial compressor, a generator driven through gears, and the regenerator This power plant will be installed in a single cab no larger than used for present-day standard locomotives

Using electric drive, the locomotive will have a generator operating at high rotative speed, so that a relatively small diameter will allow for auxiliaries or other equipment to be mounted above the generator The gas turbine's control system will be at least as simple to operate as other locomotive types

It is promised that this railroad gas turbine will be the most efficient single-shaft gas-turbine plant in this country The design includes an axial-flow compressor to compress air which will then be heated to 1300 degrees, Fahrenheit, before entering the gas turbine This will result in a shaft efficiency of approximately 24 percent

When eventually produced in quantities, gas-turbine locomotives can be expected to compare favorably in cost with other types of locomotive power, according to Allis-Chalmers engineers An outstanding fuel-cost advantage comes from the use of powdered coal, which at the same time eliminates smoke and The new locomotive will need no cinders water It will take on the same size coal as carried by the steam locomotive, but the coal will be prepared for burning with special equipment developed by John I Yellott, director of research for the Locomotive Development Committee This new coal-handling system will make use of a "coal atomizer" for powdering the fuel as well as a unique separator for removing fly ash from the heated air stream

SUPER ELECTROMAGNET

To Probe Remaining Mysteries of Magnetism

PACKING into a space the size of a saucer enough magnetic strength to lift an automobile, a "mighty midget Hercules" magnet has been developed as a tool for probing the unsolved mysteries of magnetism

Designed by Dr J E Goldman of the Westinghouse Research Laboratories, the U-shaped electromagnet is capable of exerting a concentrated pull of 4000 pounds, a force strong enough to make possible new studies of how metals react in magnetic fields

"By gaining such information," Dr Goldman explains, "we not only help unravel the mysteries of magnetism which still is a phenomenon only partially understood, but we also can help advance the work of atom-scientists and other research investigators" Also, he says, permanent magnets made with this electromagnet make possible lighter and smaller magnetic indicating instruments

As a fundamental research tool, various metals are placed within the influence of this powerful magnet, it is then possible to study the relationship between the crystal structure of the metals and their magnetic properties Although it is known that the crystal structure of metal affects the magnetic qualities, the basic processes that cause magnetism still are matters for research investigation

Contains 6000 turns of copper wire

The U-shaped iron core of the new magnet is wound with 6000 turns of square copper wire Five feet long and two and one-half feet high, the electromagnet weighs one and a half tons The two ends of iron at the top of the squat U act as the two poles of the magnet When electricity flows through the copper wire which circles the ends of the core, an intense magnetic field is set up between these two poles The air-space can be varied in size by moving the ends of the iron core closer together or farther apart and by using tapered pole pieces depending upon the size of equipment to be placed in the magnetic field and the strength of field required

The maximum width of this space is 12 inches, for tiny specimens such as silver and platinum alloy magnets, the gap is shortened to as little as one half inch

BRAZIL:
A Coming Industrial Empire

(*Continued from page* 104)

quick glimpse of the progress that Brazilian industry is making And it must not be thought that they represent merely war-time expansion As a matter of fact, the combined industries of Brazil, with a few exceptions, cannot yet begin to supply the needs of their own country For generations the agricultural economy of Brazil has made it necessary for its people to import many of their required manufactured products, it has been only within the last 15 years or so that a start has been made toward providing Brazilians with goods made in Brazil

Since Brazil is industrially still a young country, it is not at all surprising to find that many of the guiding geniuses of her industries are young men Typical of these is Francisco Pignatari, just 30 years old who heads up Laminacão Nacional de Metais S/A, and whose zeal expended in behalf of Brazilian industry makes a story strikingly similar in many respects to those so familiar in the development of American business

In 1933, Dr Julio Pignatari, father of Francisco, founded a modest industry in the rolling of aluminum foil and the production of aluminum and bronze powders This small beginning grew into Laminacão Nacional de Metais which slowly but surely established itself as a Brazilian industry in competition with imported materials When Dr Pignatari died in 1936, Francisco assumed the leadership of his father's company From that date onward, the young industrialist's vision expanded until, at the present time his company controls all of the nonferrous metals producers and fabricators whose growth has been briefly outlined in previous paragraphs Under young Pignatari's guidance, a vast amount of pioneering work has been done in developing Brazilian resources and building up the production ability of Brazilian industry

WHAT BRAZIL WANTS — In its industrial expansion Brazil needs first and foremost, machinery of all kinds Her present industrial development has been built largely through the use of second-hand and obsolete equipment imported from abroad She needs rolling mills, stamping machines, forging equipment, electric motors and electrical equipment of all kinds, lathes, presses, boring machines, and so on. Up to now there is practically no machine-tool production in the entire country, all must be imported. Switzerland and England are getting a bite of the business, business that, for the long pull, can be of great benefit to industry in the United States if the opportunity is grasped before it is too late.

In addition to machinery and equipment, Brazil needs brains, trained brains that can forward with dispatch and efficiency the up-surge of industry that is only just starting. This is not to say that Brazilian industrialists lack this essential ingredient, it is rather to emphasize the fact that American companies who want to do business with Brazil must do more than send salesmen into that country, they must send trained specialists who have a sufficiently broad grasp of international requirements to understand and appreciate the growing pains of a nation passing through a transition period, and to proceed accordingly.

Another thing. This observer did not see a single piece of safety equipment on any machine in all the plants visited. It was impossible to obtain substantiated figures on industrial accidents in Brazil, but the rate must be high. Stamping machines of many kinds were watched in operation, hand fed, the worker's fingers were constantly exposed to injury with no protection of any sort whatsoever. Here, then, is a fertile field for the safety engineer who has done so much to reduce accidents in plants in the United States. Not only should safety equipment be presented to Brazilian industry on the basis of what it can do to increase production and decrease accidents, but safety instruction in all its phases should be "sold" to them as a humanitarian—and profitable—'must" in their development program.

Materials handling is another phase of industrial production that engineers from the United States can well promote. It seemed strange to see in Brazilian plants the mixture of antiquated machinery with a few up-to-the-minute machine tools —and back-breaking manual labor furnishing the motive power for moving materials and partially fabricated parts between the points of work. Not one conveyor line was seen, and only a very few power trucks. Wheel-barrows and hand trucks did most of the actual transportation, while the sight of men and boys carrying materials in their hands was not at all uncommon!

All-in-all, despite a few faults apparent to the American eye, here is a country with the will to do, imbued with the spirit of this industrial age, emerging from a background of what amounts to a single-crop agricultural economy to a healthy and balanced economy in which agriculture and industry will complement each other. With Brazil's vast storehouse of natural resources —and her people's eagerness to make the most of them—her industrial development should be not too far different from that of the United States. The large majority of Brazilian workers have been proved ideally adaptable to industrial pursuits, to jobs requiring intelligence and developing skills. They take readily to the electrolytic plant, the foundry, the machine shop and exhibit initiative and interest in their work. They have all the requirements for the development of a group similar to that of the labor which is the backbone of industry in the United States.

Best of all is the friendliness which exists between the two nations. The United States has much to offer Brazil in the form of industrial know-how, machinery, and so on. Brazil, in turn, offers a fertile field for trade in both directions. Through international co-operation there can be an even greater acceleration of Brazilian industry to the benefit of her own people as well as those of the United States.

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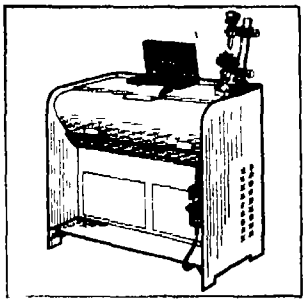

Centerless Lapping Machine

Ideal also to save time on the job is chewing gum. The act of chewing aids the workers concentration, seems to make work go easier. Furthermore, chewing gum may be used even when both hands are busy—increasing worker safety—and reducing work interruptions. That is why many plant owners have made Wrigley's Spearmint Gum available to all.

You can get complete information from
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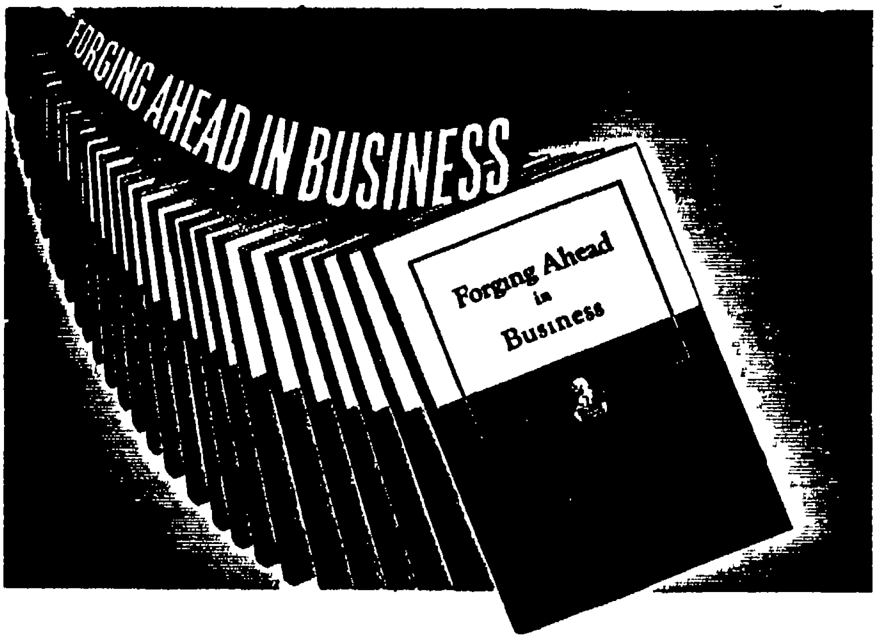

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Among the prominent industrialists who assisted in the preparation of the Course, which is described in "FORGING AHEAD IN BUSINESS" are Alfred P Sloan, Jr, Chairman of the Board, General Motors Corp ; Thomas J Watson, President, International Business Machines Corp, and Frederick W Pickard, Vice President and Director, E. I du Pont de Nemours & Co

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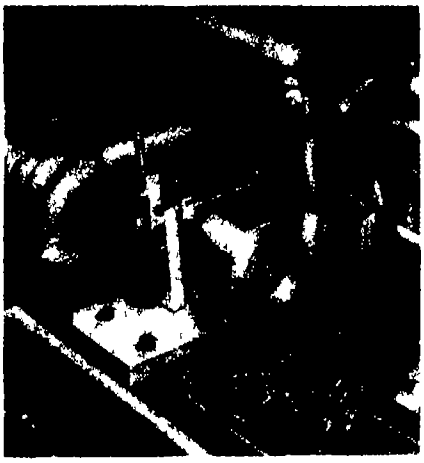

Will fit any model grinder

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HEAT-STABLE RESIN

Provides Waterproof Binding For Inorganic Materials

DEVELOPED and produced as a heat-stable bonding material for inorganic fabrics in the production of rigid electrical laminates, a thermosetting resin also serves as a bonding for finely divided particles such as powdered metals or mica, silica or carbon This material, produced by Dow Corning and known as DC 2103 is unique among thermosetting resins for its high heat stability, very low water absorption, excellent dielectric properties over a wide frequency range, and for its resistance to carbon tracking DC 2103 is an organo-silicon polymer material built on an inorganic skeleton of alternate silicon and oxygen atoms. Its unique properties are due largely to the inherent stability of this inorganic skeleton

As furnished, DC 2103 is a 60 percent solution of silicone resin in toluene Without the addition of a catalyst, this solution air dries in about an hour at 77 degrees, Fahrenheit, and 50 percent relative humidity, depositing the resin in a hard and track-free form which has an initial melting point of about 70 degrees, Centigrade, (158 degrees, Fahrenheit)

The use of this material to bond inorganic fabrics of asbestos or glass results in rigid laminations ideally suited for many electrical applications, but because of its exceptional heat-stability, waterproofness, and excellent dielectric properties, this product has many uses other than that of a bonding resin It can be used, for example, as the resin binder in the production of heat-stable and waterproof cement for sealing light bulbs or radio transmitting tubes to metal bases DC 2103 can be used also for bonding finely divided particles such as powdered metals, carbon, carborundum silica, asbestos, or mica, in the fabrication of a wide variety of products including friction-producing materials, abrasive compositions and electrical resistors

QUANTITY COMPUTER

Aids Mixing Or Diluting Oils

SIMPLE and accurate, a pocket calculator makes it possible to compute quantities in a matter of seconds when mixing or diluting oils Given the recommended mixing proportions and the capacity of the tank, the calculator, called the Dilut-O-Graph, shows precisely how much base oil to use It is circular, measuring 4½ inches in diameter, and is made of a special composition board

TRANSPARENT MIRRORS

Permit Vision in One Direction Only

VALUABLE wherever seeing without being seen is an advantage transparent mirrors function as normal reflecting surfaces when viewed from one side, and simultaneously as windows when viewed from the other These mirrors are surfaced by molecular bombardment with metal—in this case chrome alloy, although many other metals may be used—through thermal evaporation in a high vacuum Inside the vacuum chamber the chromium particles are suspended on a filament The glass to be "silvered" is placed in the chamber and after the high vacuum has been drawn, an electric current is passed through the filament The heat produced immediately evaporates the metal, molecules of which bombard the interior of the chamber and of course, the glass The resulting deposit on the glass although only ten-millionths of an inch thick, is so stable that it cannot be scratched or damaged by ordinary means, and no common chemical can attack it The mirrors are unusual also in that the metal coat is applied to the face, rather than to the back

Of the many applications for such mirrors, perhaps the most important is as observation windows in child-behavior clinics, or in psychiatric wards where surveillance of the patients without their knowledge is essential Jewelers, banks, or brokerage offices should find the mirrors a great aid in that they make close observation of customers possible with embarrassment to no one Also, the mirrors should prove convenient in restaurants and

Courtesy Rola-Lite Company

The woman, clearly visible to the man, can see only her own reflection

SENSATIONAL WAR BARGAINS
in LENSES and PRISMS

ASSEMBLE YOUR OWN BINOCULARS
Complete Optics! Complete Metal Parts!
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ARMY'S 7 x 50 BINOCULARS Here's an unusual opportunity to secure a fine set of Binoculars at a substantial saving of money Offered here are complete sets of Optics and Metal Parts for the Army's M 16 7 x 50 Binoculars (M 16 is not the water proof model) These components are new and all ready for assembly We supply full instructions Limit—1 set of Metal Parts and 1 set of Optics to a customer

METAL PARTS—Set includes all Metal Parts completely finished for assembly of 7 x 50 Binoculars No machining required Bodies have been factory hinged and covered A sturdy brown leather Binocular Carrying Case is included with each set of Metal Parts
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NOTICE! If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20 Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled

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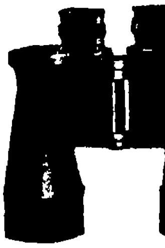
Stock #830 S $40 00 Postpaid
plus $8 00 tax — Total — $48 00

COMPLETE OPTICS & METAL PARTS — Model M 3 6 x 30 Binoculars The Optics in this set are new perfect or near perfect Prisms have new low reflection coating Factory mounted Eye Piece and Objective Assemblies *not coated* Metal Parts are perfect new ready for assembly When finished this will look like a regular factory job except a name has been filed off a cover plate No machining required Bodies factory hinged and covered
Stock #831 S $[illegible] 00 Postpaid
plus $7 00 tax — Total — $42 00

METAL PARTS ONLY — Model M 13A1 6 x 30 Binoculars No Optics Same Metal Parts as described for Stock #830 S
Stock #832 S 6 x 30 Metal Parts $[illegible] 00 Postpaid

METAL PARTS ONLY — Model M 3 6 x 30 Binoculars No optics Some machining on these Metal Parts required Bodies hinged and Prism Shelf holes placed but you must tap them Prism Shelves have been machined Six lead spiral focusing threads have been cut Some less difficult components you must thread and machine yourself but all material you need is furnished except body covering material and Optics
Stock #833 S 6 x 30 Metal Parts $12 00 Postpaid



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ARMY'S 6 x 30 BINOCULARS (Cont'd)

METAL PARTS ONLY — Model M 3 6 x 30 Binoculars No Optics All parts you need You must do machining on most parts but not all No body covering material
Stock #834 S 6 x 30 Metal Parts $6 00 Postpaid

OPTICS FOR 6 x 30 BINOCULARS (No Metal Parts) Slight seconds Cemented but not coated
Stock #5123 S $10 00 Postpaid

SAME OPTICS AS Stock #5123 S (6 x 30) but coated
Stock #5124 S $12 75 Postpaid

If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20 Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled

Optics and Metal Parts are Available for Monoculars (½ a Binocular) For Complete Details, Write for Bulletin #14 S

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With Polarizing Variable Density Attachment

Can be used as Slide Viewer or take it apart and you can get Polarizing Variable Density Attachment Mangin Concave Mirror Reflector Plate Metal Reticle Window Lamp Housing Ring and Bead Sight The Polarizing attachment alone is worth many times the price of entire unit Consists of 2 Polarizing Filters mounted with small handle which rotates one around the other May be used in Photography Research Experiments as Light Dimmer etc
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What Strange Powers Did the Ancients Possess?

EVERY important discovery relating to mind power, sound thinking and cause and effect, as applied to self-advancement, was known centuries ago, before the masses could read and write

Much has been written about the wise men of old A popular fallacy has it that their secrets of personal power and successful living were lost to the world Knowledge of nature's laws, accumulated through the ages, is never lost. At times the great truths possessed by the sages were hidden from unscrupulous men in high places, but never destroyed

Why Were Their Secrets Closely Guarded?

Only recently, as time is measured, not more than twenty generations ago, less than 1/100th of 1% of the earth's people were thought capable of receiving basic knowledge about the laws of life, for it is an elementary truism that knowledge is power and that power cannot be entrusted to the ignorant and the unworthy

Wisdom is not readily attainable by the general public, nor recognized when right within reach The average person absorbs a multitude of details about things, but goes through life without ever knowing where and how to acquire mastery of the fundamentals of the inner mind—that mysterious silent something which "whispers" to you from within.

Fundamental Laws of Nature

Your habits, accomplishments and weaknesses are the effects of causes Your thoughts and actions are governed by fundamental laws Example The law of compensation is as fundamental as the laws of breathing, eating and sleeping All fixed laws of nature are as fascinating to study as they are vital to understand for success in life

You can learn to find and follow every basic law of life You can begin at any time to discover a whole new world of interesting truths You can start at once to awaken your inner powers of self-understanding and self-advancement. You can learn from one of the world s oldest institutions, first known in America in 1694 Enjoying the high regard of hundreds of leaders, thinkers and teachers, the organization is known as the Rosicrucion Order Its complete name is the "Ancient and Mystical Order Rosae Crucis," abbreviated by the initials "AMORC" The teachings of the Order are not sold, for it is not a commercial organization, nor is it a religious sect It is a non-profit fraternity, a brotherhood in the true sense

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Sincere men and women, in search of the truth—those who wish to fit in with the ways of the world—are invited to write for a complimentary copy of the booklet, "The Mastery of Life" It tells how to contact the librarian of the archives of AMORC for this rare knowledge This booklet is not intended for general distribution nor is it sent without request It is therefore suggested that you write for your copy to the Scribe whose address is given in the coupon The initial step is for you to take

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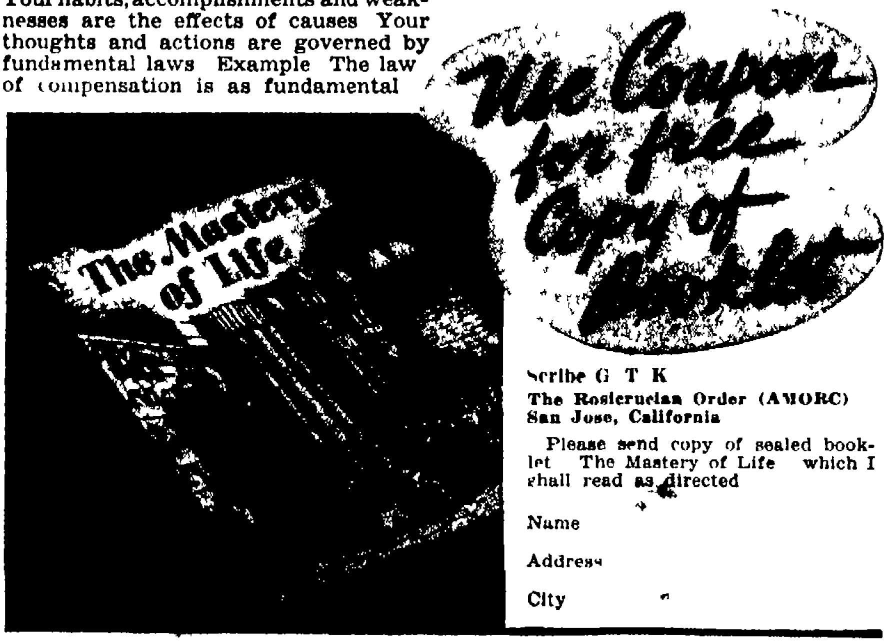

night clubs where they would enable the waiter to watch his patrons, serving their every wish, without that annoying hovering-about

The mirrors, developed to be used in various types of equipment for the army and navy, are now being produced commercially by both the Acra-Lite Company, and Libbey-Owens-Ford Glass Company

ADHESIVE LABELS

Cannot be Removed In One Piece

SELF-DESTROYING labels which cannot be reused once they are removed were especially designed for trade-marks, underwriter's approval seals, and similar factory-applied data, they cannot be removed from the genuine product and placed on substitute merchandise Their unusual self-destroying feature is accomplished by die cutting the label so that it can be removed only in segments The die marks, however, are impressed in such a manner that they are virtually invisible and in no way affect the design on the label

Fraudulent re use impossible

Manufactured by the Avery Adhesive Label Corporation, labels may be applied to metal, plastics, wood, varnish, glass, or cellophane, and unless their removal is desired, they will adhere permanently despite intense heat, cold, or humidity

RAYON LAMINATES

Have High Strength, Great Versatility

UTILIZED in the molding of articles such as cabinets, table tops, trays machine parts and household utensils, an increasing variety of rayon laminated plastics are being manufactured by the American Viscose Corporation

Rayon laminated plastics which have good tensile and high impact strengths consist of a number of layers of resin-treated fabrics or fibrous mats laid together and pressed into a compact bonded plate or molded article For special applications where major strength is needed in one direction in the laminate, unidirectional high-tenacity rayon fabrics possess particular merit For different applications a square or twill weave will be found more desirable Other forms in which rayon is used for laminated plastics are carded batts, ribbon lap, loose fiber or thin sheets of non-woven fabric, depending upon the particular characteristics needed and the method of handling or molding

Rayon, when used as a resin treated batt or in the form of a ribbon lap, is readily molded into various forms and it is then possible to obtain a uniform, smooth, and attractive surface Heavy laminated plastics sections made from resin treated rayon staple batts have also been developed for gear-wheel stock and other machined reinforced plastics parts It is also possible to make laminated plastics from rayon fiber blends, dry processed on textile equipment or wet processed on paper-making equipment with the suitable addition of resin

AUTOMATIC TYPEWRITER

Prints Form Letters With Personal Touch

THE PROBLEM of giving automatically reproduced form letters that individually typed look has found another solution in a device which enables one person to prepare as many as 600 personalized letters in a single eight-hour day This device, called the Flexowriter Automatic Letter Writer, operates by means of a perforated paper tape, and consists of an electric typewriter, an automatic perforator, and an automatic writer

The chief advantage of this new system lies in the fact that it is impossible to detect any variation between the manually typed fill-in and the automatically typed body of the letter This is the result of, first, the fact that in using an electric typewriter, the pressure of the type-face against the ribbon is the same, regardless of the pressure applied to the key, so that the impression is the same, whether the typing be done manually or automatically, and, secondly, of writing the letter from start to finish on the same machine without its having to be removed during the entire operation

Guided by holes in tape, letters are typed automatically leaving the operator free to check her mailing lists

The master copy of the letter to be reproduced is recorded by the perforator on a paper tape 7/8 inch wide The perforating is done at the operator's normal typing speed, and if any error in typing is made, the correction is completed by simply back-spacing and x'ing out the mistake The automatic writer will disregard any characters so crossed out.

In preparing the form letter, the operator types manually the date and the name and address of the recipient Then a switch is thrown, and the automatic writer takes over, controlled by the previously prepared tape, and finishes the letter in less than half the time required for manual typing While one machine is on automatic, the operator can be preparing the personal data on another, the average operator can handle a battery of four machines without difficulty Using this procedure, a great many letters which defy detection from those individually typed can be prepared in a very short time

Controlled by the electric typewriter, the automatic perforator at extreme right records on a narrow paper tape the body of a letter to be reproduced

FIRE BLANKET

Is Versatile Safety Aid

A VALUABLE safety and emergency aid to industrial plants, laboratories, hotels, and fire departments, is a new fire blanket now being manufactured by United States Rubber Company

The blanket can be used as an emergency wrap should a person's clothing be aflame, as an auxiliary fire extinguisher to put out flames from vents, manholes, small containers, or tanks as a fire shield so that fire fighters can approach within effective range of liquid fires, as a welding screen against sparks, and as a salvage blanket to protect valuable materials from water, chemicals, and heat

It is 60 by 80 inches in size and made of high tensile strength glass cloth impregnated on both sides with synthetic rubber Hems and seams are vulcanized and folds are heat creased It is equipped with large brass grommets at the top and a weather-resistant bracket so it can be hung up outdoors or indoors and easily removed or replaced For quick identification, it is red in color and marked with the words "fire blanket"

Qualities claimed for the fire blanket are that it is flame-proof, heat re-

Accuracy in production operations is an important factor in the quality and performance of a finished product Production accuracy begins in the toolroom where the production tools, gauges, dies, jigs and fixtures are made To be doubly certain of product quality, many industries use South Bend Precision Lathes not only in their laboratories and toolrooms, but in their production shops as well South Bend Precision Lathes may be the solution to some of your product quality or production problems, too

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I'm seeking a producer for a uniquely striking simply designed dentifrice dispensing toothbrush and a screw-on cap for replenishing the dentifrice. As a traveler's item alone it has a huge market

This new type toothbrush, upon which patent is now pending, is fabricated with a hollow handle Before brushing the teeth an arm riding in a slot on the side of the handle is moved forward to operate a plunger that forces paste through an opening between the bristle tufts

If you now have any kind of brushes in production, it will be a simple matter to adopt the special feature of this item and increase your sales to a widened market On the other hand, if the item is new to your firm here is an opportunity to put an easy to make article before the public in record time.

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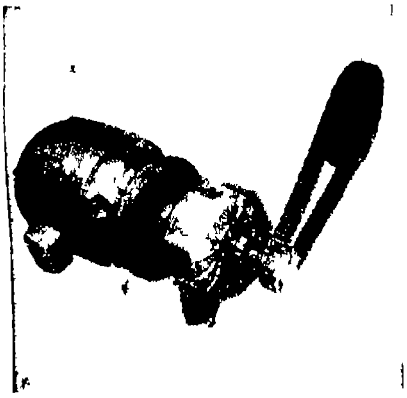
ELECTROFLUID DRIVE

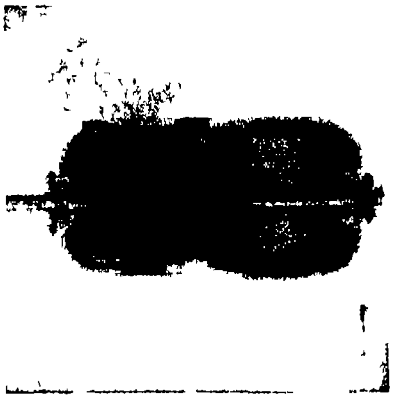
Provides Smooth Power Flow While Protecting Equipment

CONSISTING of a general-purpose A C induction motor, flange-mounted on a sturdy housing that contains an hydraulic coupling, the new Electrofluid Drive is a neat, compact power unit now available for many industrial uses The hydraulic coupling, operating on a long established principle, consists of a primary and secondary element, the primary is similar to a centrifugal-pump impeller and the secondary, or output element, is not unlike a waterwheel or runner in function The coupling is filled with a light mineral oil of steam-turbine quality When the motor drives the impeller, it causes oil to flow through the runner buckets back to the impeller, thereby rotating the runner through the medium of the oil There is no mechanical connection between the two elements of the fluid coupling

In effect, the fluid coupling inserted between the motor and its load serves as an automatic clutch with the fluid acting as a "cushion' between prime mover and driven machine


Power unit in operation

Without need of any complicated starting control or special type of motor, Electrofluid Drive solves the problems of inadequate torque and excessive high starting current peaks Regardless of the characteristics or inertia of driven machine or connected load the motor of the Electrofluid Drive starts at no-load, because at zero speed the torque-transmitting capacity of the fluid coupling is zero The motor accelerates quickly, developing torque in the fluid coupling in the ratio of the square of the speed, until sufficient torque up to the maximum running torque of the motor is developed to start the driven load


Cross section shows induction motor (right) and hydraulic coupling (left)

Should the driven machine become stalled, the Link-Belt Company's Electrofluid Drive will pull to the maximum torque capacity of the motor, thereby drawing sufficient current to cause the thermal overload protective device to function within a few seconds Thus the drive will overcome a momentary demand which might otherwise shear a pin or stop the power source completely This cushioning effect protects both the motor and the driven equipment

GLOWING TUBE

Serves as Marker In the Dark

HIGHLY flexible luminous tubing, originally produced for specialized war-time use, offers interesting possibilities for peace-time applications Made by the United States Radium Corporation, the tubing comprises a tough, semi-transparent, moisture- and acid-resistant plastics ¼ inch outside diameter and 3/16 inch inside, uniformly coated on the inside with a radioactive material which is clearly and continuously visible at a considerable distance in complete darkness

In its original specifications, the tubing was prepared in five-foot lengths and equipped at the ends with snap-clip fasteners The armed forces used it as a marker for night parachute drops, as a marker for ship passageways during blackouts, and for other similar purposes

REMOTE THERMOMETER

Transmits Readings by Air-Pressure Medium

CONVERTING temperature to air pressure and transmitting this pressure to a receiving indicator, recorder, or controller, a new type thermometer operates on a pneumatic "null" balance principle in which the pressure in a gas-filled thermal element is balanced by air pressure The instrument pro-

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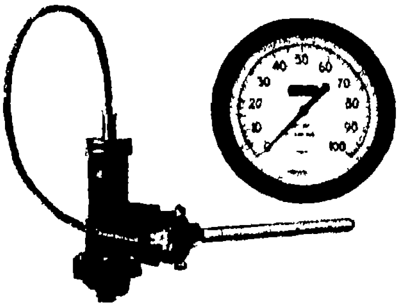
vides high-speed pneumatic transmission of the measured temperature over distances of 1000 feet or more and eliminates the need for long lengths of capillary tubing

The gas-filled thermal element is said to be of an entirely new design, consisting of a bulb, double-armored capillary only 24 inches long, and a sealing bellows Thermal elements are interchangeable The pressure of the gas fill does not determine the operating range of the instrument, called the Nullmatic Thermometer Standard thermal elements with either of two filling pressures serve for temperatures as low as minus 150 degrees, Fahrenheit, and as high as 800 degrees Fahrenheit

The low filling pressures used result in an instrument which has high overload protection, hence thermal elements for sub-zero applications require no special provision for shipment or storage Because the transmission is pneumatic, the 30 pounds per square inch supply-air pressure is the highest pressure to which the transmitter and receiver are subjected

The operating range of any Nullmatic thermometer may be reset over wide limits by the use of a suppression adjustment in the transmitter which is also used for setting zero There are no linkages or bearings in the transmitter Standard instruments are furnished to operate over Fahrenheit spans of 100, 150, 200, 300, 400 500, 600, and 800 degrees, Fahrenheit, or in Centigrade spans up to 450 degrees

The instrument responds to temperature changes as small as 0 01 degree, Fahrenheit, and detects and transmits temperature changes with a lag coefficient of only 2 4 seconds—bare copper bulb in a well-agitated liquid The speed is not affected by transmission distances up to 75 feet The addition of each 100 feet of line results in a transfer lag of approximately one second



Long capillaries unnecessary

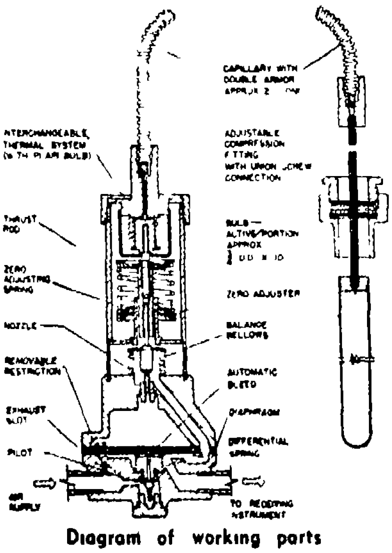


Diagram of working parts

SIX-STATION TURRET

Increases Efficiency of Lathe Operation

Designed to give turret-lathe efficiency to nine-inch South Bend lathes on jobs which require a number of successive operations is a new tailstock-type Hand-lever Turret which mounts on the inside ways of the lathe bed in place of the tailstock This six-station turret head accommodates tools with ⅝ inch diameter shanks The length of the cut at each station is regulated by an adjustable set screw, and the stop mechanism is geared to operate automatically in unison with the indexing of the turret head The index lock releases automatically at the end of the turret slide's return stroke and indexing is done by hand Operations can be repeated, or skipped, at will, and the turret slide has a maximum stroke of 3¼ inches

Accommodates 5/8 inch diameter shanks

FLEXIBLE GLASS CUTTING

Facilitated by Use Of Carbide Saw

Difficulties in keeping sharp the saws used for cutting out shapes for ice-resistant propellers and wing tips has been solved in a simple manner by one manufacturer The material used —1/16 inch thick sheets of Flexible Glass (a glass-impregnated fabric)—proved so abrasive that ordinary saws averaged only 20 minutes between regrinds In an effort to put the operation on a production basis, the manufacturer tried a saw tipped with Carboloy Grade 905, a cemented carbide possessing extremely high wear-resistance Service life between grinds increased several hundred times over that previously obtained from the high-speed steel saws

Cutting was performed with a Black and Decker hand-guided power saw at a speed of 20,940 feet per minute without coolant, using hand feed The Carboloy tipped saw was used in this manner in regular production for 90 days without re-grinding In this time, it is estimated, some 60 high-speed steel saws would normally have been consumed Thus, the change-over resulted

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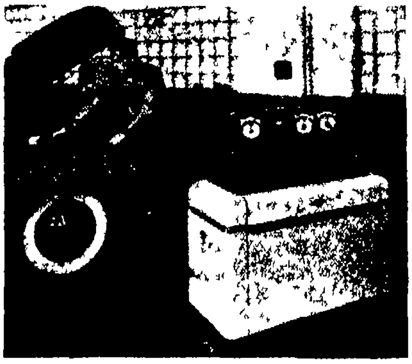
To eliminate double handling of oil, and reduce contamination and waste, as well as to speed up service and save time, a new installation dispenses motor oil direct from 55-gallon original refinery containers to the automobile or truck crankcase without the use of measures funnels, or can openers

Called Lubreel installations, the system employs pumps and containers placed in out-of-sight or remote locations, and oil is piped direct to the Lubreel which can be located along side of or between vehicle lifts



Oil servicing simplified

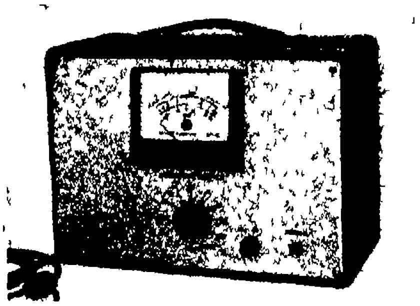
All hose assemblies are mounted on individual, air-operated, automatic retracting reels Each control valve is equipped with an easy-to-read, totalizing meter which accurately registers the amount of oil being dispensed, according to the manufacturer Lincoln Engineering Company

AUDIO VOLTMETER

Is Highly Sensitive Over Wide Frequency Band

Designed to measure A C voltages over ranges of frequency and amplitude far beyond the limits of ordinary meters, a highly sensitive vacuum tube audio voltmeter makes it possible to measure the electrical conductivity of switches, circuit-breakers, relays, buses, and grounds, as well as transmission losses in lines and circuits and the response of special filters and compensators Covering a range from 20 cycles to 20 kilocycles, the instrument is applicable for testing radio receivers and sound systems and is used to measure gain and noise level in power amplifiers and ripples voltages in power supplies The meter is also used to locate sources of frequency distortion and faulty amplifier components in receivers, phonographs, and public address systems

Other applications of the new audio voltmeter, manufactured by the Radio Corporation of America, include use as an audio amplifier which gives high gain with high fidelity, and whose sensitivity makes it especially adaptable for use with microphones having low output, bridge measurements which readily indicate the null point at either high or low audio frequencies, measurement of the output of a phototube with sensitivity that will indicate extremely slight variations in light intensities to which the tube is exposed, and measurement of currents as low as one one-thousandths of an ampere or, if a 0 1 megohm external resistor can be used, currents as low as 0 0001 milliampere



Amplifier or voltmeter

WOOD-METAL LAMINATES

Are Light, Rigid, And Fire-Resistant

Lighter planes, fireproof office partitions, and desks which resist cigarette burns are all made possible by combining metal and plywood layers, according to Thomas D Perry of Resinous Products and Chemical Company Plymetal is a relatively new product which combines the good qualities of both wood and metal, and compensates for the less desirable qualities of each It is made by gluing layers of metal to sheets of veneer with a resin adhesive, to which heat and pressure are simultaneously applied Among Plymetal's many applications is a table-top construction developed for office desks, bank counters, and smoking stands, where an inserted sheet of aluminum is provided to absorb and distribute the heat from lighted cigarettes so that the outer wood surface is not disfigured

Kitchen equipment, table tops, and drainboards are much improved by metal surfaces for cleanliness and wear, backed by a light-weight plywood for stiffness and heat insulation Here both steel and aluminum are employed Many types of hospital equipment benefit by the same Plymetal constructions and are easily kept surgically clean

Plymetal has proved valuable also for interior enclosures in zoned areas of cities where a fireproof or non-combustible barrier is required by code for instance, in elevator cabs, stair wells, and office partitions

In aircraft, where strength to weight ratios are of maximum importance sandwich constructions with aluminum-alloy surfaces and low-density interiors have developed remarkable stiffness and have been a great boon to aircraft designers in floors, cockpits, and bulkheads

The transportation industries have

used Plymetal in locations where the metal face resists wear and abrasion, and adds strength, while the plywood backing contributes stiffness and keeps down the weight Examples of such applications are the floors, sides and operator cabs for trucks, walls and roofs for buses, and many parts for light-weight streamline railroad cars In these, steel-plywood constructions were employed

SOLAR TIMER

Throws Switches at Rise and Set of Sun

Clocks with "astronomic dials' turn lights or other electrical equipment on at sunset and off at sunrise throughout the year automatically without any attention. They may be set to operate exactly at sunset and sunrise or up to 40 minutes before or after Provision is also made for them to turn off at a fixed time, if desired, anywhere between 11 P M and 1 A M The dial is equipped with a calendar wheel showing the month and day as well as exactly when the switch will operate These clocks, manufactured by the Tork Clock Company operate on Standard Time throughout the year and are set for the exact time correction (the variation from a Standard Time Meridian) for the city or town where used

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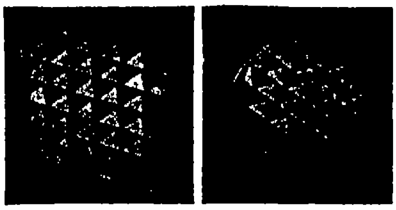

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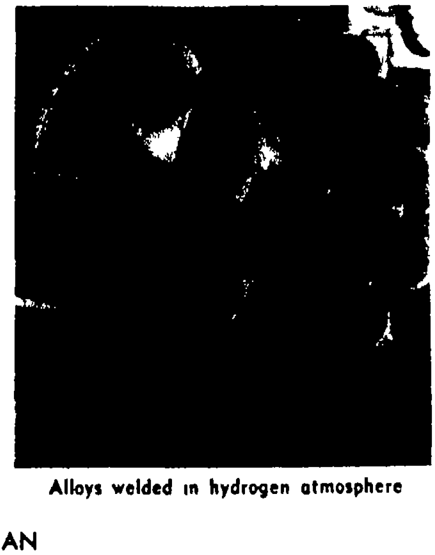
Heat-resistant alloys in general are classed as stainless steels, and are likely



Alloys welded in hydrogen atmosphere

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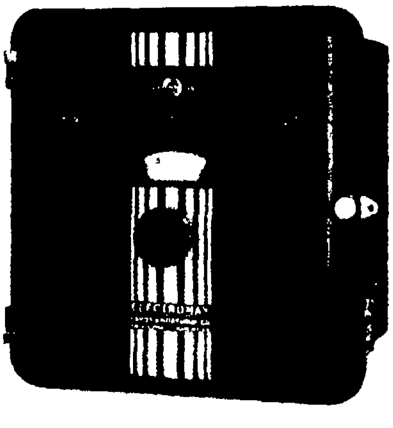

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Blueprints for Medicine's Tomorrow—Industrial and Social Medicine This 32-page booklet is one of a series of booklets on specific projects in the plan for the development of the New York University-Bellevue Medical Center Essentially a prospectus for an Institute of Industrial and Social Medicine at this center, it covers the past and future of preventive medicine, New York University's' record in public health, plans for the proposed Institute, and the initial research program *New York University Book Shop Washington Square, New York, New York — $1 00*

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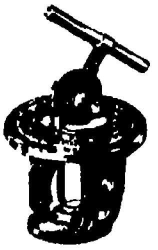

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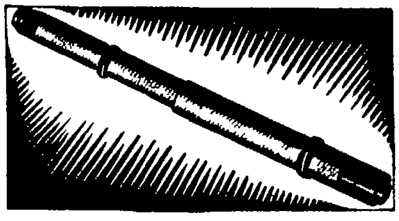

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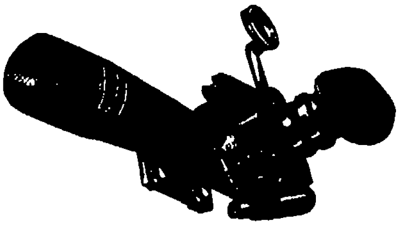

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Telescoptics

A Monthly Department for the Amateur Telescope Maker

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Editor of the Scientific American books 'Amateur Telescope Making' and "Amateur Telescope Making—Advanced"

LAST June this department contained an account of what Russell Porter did to help win the war, and showed a photograph of him lying on a sofa reading *The Los Angeles Astonisher* while his newly made polishing machine slaved directly beneath him in the cellar The war over, he was enjoying a little well-earned rest

Now we have asked him to tell the telescope-making fraternity about that machine and here is his reply, illustrated with some of his incomparable drawings He writes

Long past retiring age (75 last December) I still find myself fascinated with working optical surfaces So I obtained three 8" Pyrex blanks and went down cellar where at odd moments I tried to make them flat

The machine used (Figure 1) embodies the Scotch yoke principle which favors compactness Its base is a plank one foot wide and two feet long and it has a capacity up to 12" work The ⅛ horsepower driving motor has a worm directly attached to the end of its armature shaft To the top of the large worm wheel is attached a flat, circular plate, its upper face carefully faced and lubricated In that plate, extending from center to the edge, is a single radial slot Locked at any desired position along the slot by means of the nut shown in the drawing, is a shouldered stud Loose on that stud is a roller which fits the inside of the shouldered slot of the Scotch yoke shown As the worm wheel rotates the Scotch yoke unit is forced to reciprocate constrained as it is by its guide rod The other rod, the upper one, which carries the pin that pushes and pulls the work, has a rocker which confers freedom of action over any convex or concave surface

With the adjustments set as shown, a straight-over-center (radial) stroke of about 5" is given (the slot, 3' in length, permits a 6' maximum stroke) A complete stroke is made in about two seconds

A thumb-nut on the upper rod—the push rod—affords quick change of stroke range If now it is desired to change to an off-center (tangential) stroke it is necessary only to loosen the little clamping lever near the base of the main casting, rotate the entire unit a little, and re-tighten the clamp Thus the tool may be made to operate over any part of the glass

The vertical shaft has a sprocket pinion which, by means of a sprocket chain, rotates the work table at a reasonably slow speed An idler takes up any slack There are no creeping belts I have noticed no tendency to produce periodic errors on the glass being worked The only casting required is the one embracing the Scotch yoke

Now for the figuring of the 8" flats I first tried the interference method described in "A T M," page 52 The fringes were normally observed some 10' away by introducing a sheet of window glass at 45° just over the disks The illumination is from a 2' mercury tube suspended from the ceiling with tissue paper below it for scattering the light

The three disks slowly approached flatness, with an error of the order of half a fringe or a quarter wavelength Then, as an independent check and after considerable urging by Dr Anderson I made an 8" concave mirror of about 10' radius of curvature With this set-up and a newly made knife-edge stand (Figure 2) I checked the flatness as described in "A T M " page 42 As is called for in the figure on that page, three motions were provided one vertical (*A*), one transverse (*B*), and one longitudinal

At *a* is an enlarged view of the knife-edge window With the pinhole image as shown, near the upper left-hand corner of the window, only a slight turn of the screws *A* and *B* will give the vertical and horizontal cutoffs All three movements are controlled by gibs, and the screws (standard 1¼" diameter, 20-pitch) act against coil springs to prevent backlash by preloading

The illuminant is a grain-of-wheat lamp bulb covered with a wafer of finely ground glass There are four pinholes in the little diaphragm shown of varying sizes, to choose from The bulb runs on two 1½-volt flashlight batteries The trough shown below the window is for an eyepiece, used when studying extra-focal images It can be swung out of the way when observing the Foucault shadows

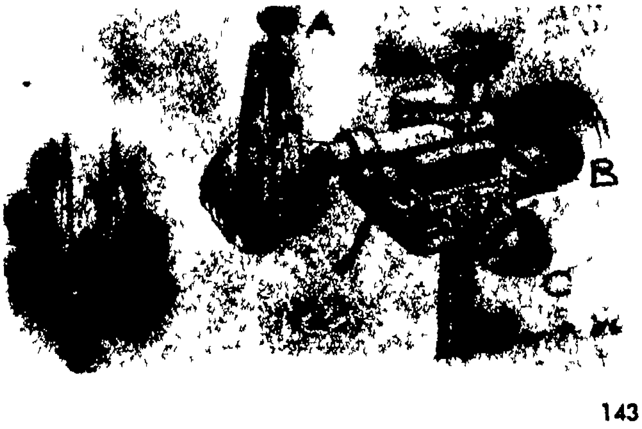
Comparison between the interference and concave mirror methods of testing indicates that there is about the same degree of sensitivity and the two are mutually consistent throughout At present all three disks are flat to 1/20 fringe, or 1/10 wavelength, which means departures from flatness of two millionths of an inch They are not as good as those described by Selby, since they all have turned down edges of about one fringe

Porter was asked about scale drawings of the knife-edge stand, since readers will inquire None exist The drawing is practically self-explanatory Dimensions need not be identical with those of the original Pick your own Porter added, "Yes, made it myself filed all the gibs"

RUMORS about inexpensive mirrors and lenses of plastics for astronomical telescopes persist You'll soon be able so 'tis said, to buy standard mirrors made in simple master molds and precise to 1/20 wavelength, figure perfect, for about five dollars And of course after that you may feel a bit foolish working long hours over glass mirrors made individually

Many puzzled amateurs have asked about these rumors Are plastics optics then that good? Or are they likely soon to be that good? Let's look at the evidence

In 1940, N R D C in final analysis the Government awarded the Polaroid Corporation, Cambridge, Mass, a contract to do research on and develop plastics optics Polaroid investigated 140 organic plastics and chose two as best for optics To correspond with crown glass they selected polycyclohexyl methacrylate or "CHM" (Nd =



Left Figure 1 Porter's slavey Right Figure 2 Knife edge stand made by Porter

1.50645, v = 56.9) and to correspond with flint glass they picked polystyrene (Nd = 1.59165, v = 31.0). These plastics may be poured, in molasses-like consistency, into molds made from glass masters made by conventional precision optical methods—hand work. Bake the filled molds in ovens and you have mirrors, prisms, or lenses.

The optics made from these materials weigh only half as much as glass, are homogeneous, tough, substantially free from color, haze, and strain, and are stable under temperature extremes. They are, however, soft and more easily scratched than glass.

Such optics were useful in the War as they could be made by inexperienced help, and this released precious optical glass for other purposes. Today the largest use for plastics optics is in the projection systems of television sets. Here the Schmidt camera is used, reversed. This application affords an opportunity to compare plastics optics with glass optics.

A 12 telescope mirror, precision grade (1/10 wavelength), will resolve objects 0.38 second of arc apart, by the Dawes' formula. The corresponding 12" Schmidt with plastics optics as used in television resolves objects 2 minutes of arc apart. Ratio, 300 to 1, though for lenses, which have only one fourth as stiff a tolerance as mirrors, this ratio softens 75 to 1. (But of course, this says nothing against plastics Schmidts for television, where the 2-minute resolving power is sufficient and where increased production costs due to needless refinement would therefore be sheer waste. Simply the 2-minute resolution approaches the 1-minute resolving power of the human eye.) In astronomical work it is pretty well established that a circle of confusion of 100 microns (1/250") diameter is adequate. The 12 plastics mirror of 12' radius mentioned above, would give a circle of confusion 1.2 mm, or about 1/20", in diameter—hopelessly large for a star image.

Thus is has proved possible to make and use telescopes and binoculars of plastics magnifying about three or four diameters. To supplant glass precision optics, better than this will have to materialize. Far, far better.

In a paper read before the Optical Society of America, Edwin H. Land, Director of Research of the Polaroid Corporation, objectively assessed the usefulness of plastics optics, making no attempt to claim, or imply, more than observable facts justified. He answered the question, can optical plastics be formed into elements sufficiently homogeneous, accurate, and stable to meet the requirements of precision optics? The following is written with that paper as its basis.

A plastics material in liquid form is poured into molds consisting of accurately ground and polished Pyrex reverses assembled with flexible tape so that the halves may approach each other during baking, and baked. The optical elements thus produced prove to be constant in refractive index within ± 0.0015, most of them being considerably better. Over a subsequent period of eight months this index may change four or five parts per million.

In other experiments, disks 1" thick and 6" in diameter, cast between two optical flats, flexured 6 to 20 fringes after removal from the mold. In four CHM lenses of 169cm focal length and 12 styrene lenses of 144cm focal length cast in reverse molds the variations in radius of curvature affected the focal powers over a range of something under 0.4 percent.

In casting prisms from flat molds there was greater trouble. The facets came out of 5 to 10 fringes from flat, with angle accuracy ± 15 minutes.

In plastics optics it is as easy to cast aspherical elements such as Schmidt corrector plates good enough for television as it is to cast a sphere. Another advantage is the lightness of the optical elements. Some samples which were sent to this department seemed, by unconscious comparison with glass almost ready to blow away, they do almost float in water. Plastics optics can be drilled, tapped, turned, shaped planed, or milled with ordinary metal-working tools. And they can be aluminized. They take a precision optical polish and are highly transparent.

In an objective lens, CHM combined with flint glass permits removal of nearly all the secondary spectrum.

Regarding plastics camera lenses. An experimental aerial camera lens of f/2.8 and 7½' focal length was made with four elements of styrene and CHM and one thin element of barium crown glass. It was tested at the Mt. Wilson Observatory beside an excellent f/2.5 all-glass lens of 7.1" focal length. The performance of the two lenses was found to be practically equal for half-field angles smaller than 14° but the glass was better at greater apertures. The plastics lens has negative astigmatism and curvature of field up to 15° from the axis, the astigmatism rapidly increasing thereafter. The distortion curve is of unusual shape flattening out for large field angles. Spherical aberration and its chromatic variation is smaller for the plastics objective than for glass and the color curve is better adapted to the use of pan film with a yellow filter.

The coefficients of linear thermal expansion of CHM and styrene are 7 to 8 times that of common glasses, and their change of index with change in temperature is about 45 times as much. Protection from non-uniform temperature changes is necessary in systems containing massive plastics elements because of their low thermal conductivity which is about one tenth that of glass. In reflecting devices such as Schmidts temperature compensation may be had by making the mountings of material having the same thermal coefficients as the mirror.

In sum, then, the plastics optics named provide accuracy equal to the demands made by telescopes magnifying about four diameters and by camera objectives up to about 10" focal length. The prisms are far from good enough.

Plastics have a long road to travel before they come within even distant sight of existing precision optics. What of the future? Nobody knows the future.

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(Condensed from Issues of April, 1897)

NIAGARA BRIDGE — "On Sunday, March 28, the last panel of the great new steel arch bridge across the Niagara gorge was put in place and the arch proper finished · The length of the main span of the arch is 550 feet between the centers of the end pins This span is connected to the cliff on either side by a trussed span 115 feet in length. All told, there will be in the arch when completed over 6,000,000 pounds of steel. Of this amount it is estimated that there will be about 5,580,000 pounds of steel plates and angles, 218,000 pounds of steel castings, 182,143 pounds of eye bars and pins, and about 30,000 pounds of wrought iron rods, etc"

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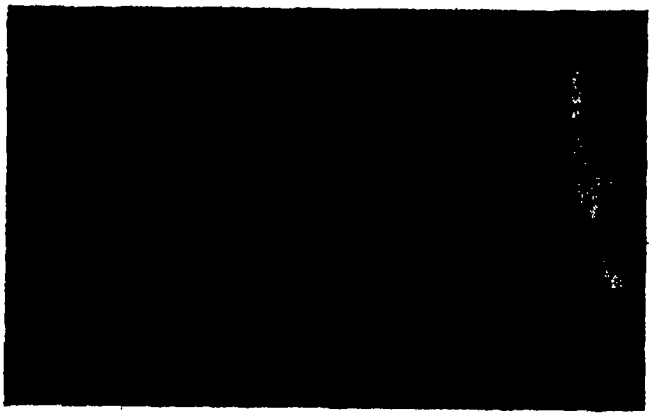
WIRE MAKING — "According to a contemporary the English manufacturers of wire rods, wire, and wire nails are threatened with the loss of their business in consequence of the successful competition of Germany and other Continental countries and of the United States The rivalry of Germany is of long standing and has become an accepted fact, whereas that of the United States is a more recent and has grown to be a much more formidable feature"

STEAM TURBINE — "The closed cylinder steam engine is finding a formidable rival in these later days in the steam turbine, or rotary impact engine In these machines the energy of the steam is utilized by discharging it at an enormous velocity against the buckets of a wheel The accompanying illustration shows a three hundred horse power De Laval steam turbine which is running very successfully at the Twelfth Street station of the Edison Electric Illuminating Company, New York City The steam is led into a circular steam tight casing in which is located the turbine wheel. This wheel has a diameter of 29½ inches, and runs at 9,000 revolutions per minute, the speed of the buckets being 1,160 feet per second. The blades are arranged around the periphery and are milled out of the solid steel spokes with which the wheel is built up They are made very thin at the edges and are of a curved cross section."



DEEP HOLES — "The deepest bore hole in the world, says Mr C Zundel, in a late communication to the Industrial Society of Mulhouse, is one of 6,571 feet below the surface of the soil, made at Parnschowitz, near Rybrick, Upper Silesia. The previous record for depth was the 5,733 foot hole drilled some years ago at Schladebach, Leipzig"

RAIL MEASUREMENTS — "An ingenious device has been gotten up by Mr P H Dudley for the purpose of learning the amount of depression of railroad rails under moving trains It is an electrical contrivance which is firmly attached to the base of the rail in such a way as to register automatically the elongation and compression of the rail as the train passes over it. Experiments with this little instrument prove that the deflecting pressure on a rail from a moving train is from ten to twenty times as great as was calculated from theoretical considerations"

CARBORUNDUM — "The Carborundum Company reports that its works have produced during the year 1896, in round numbers, 1,191,000 pounds, or 595¼ tons, of crystalline Carborundum."

BALL TESTING — "The following method has been adopted for testing the hardness of steel balls A plate of glass is inclined to the horizontal and the balls dropped on this one by one from a definite height The rebound of the ball, if properly tempered, is sufficient to carry it into the hopper, where the hard balls are thus automatically collected. Soft balls, rebounding less, fall into another receptacle"

100 Years Ago in

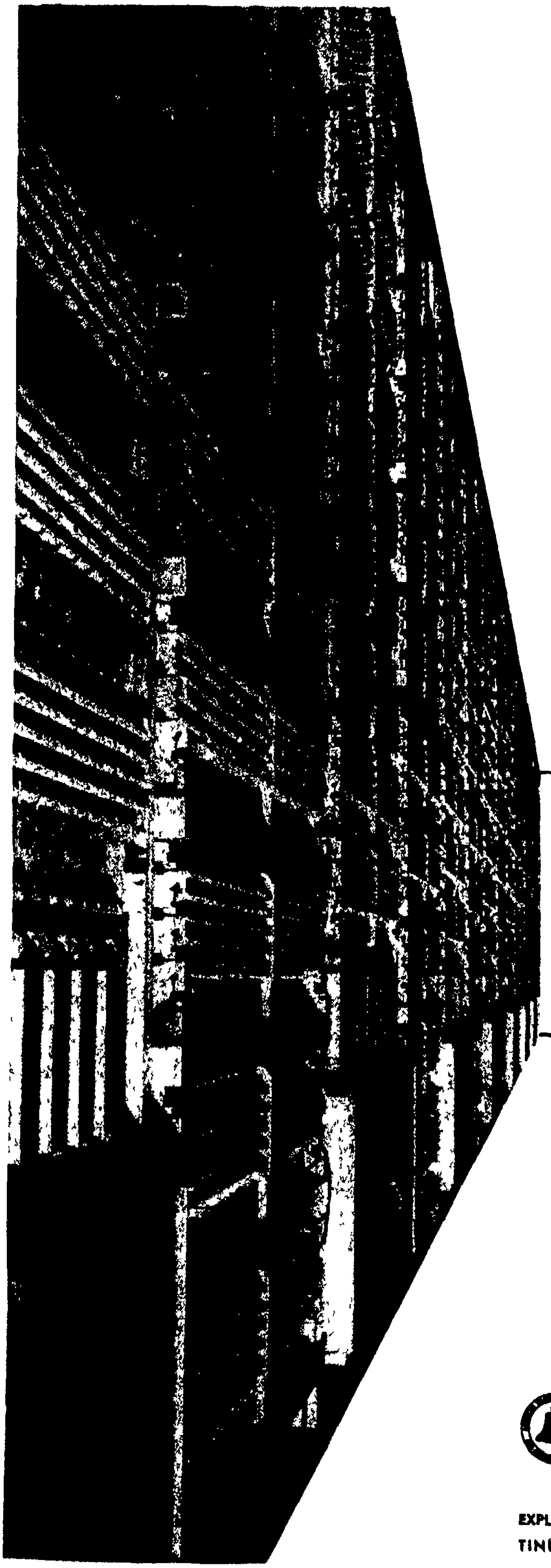
(Condensed from Issues of April, 1847)

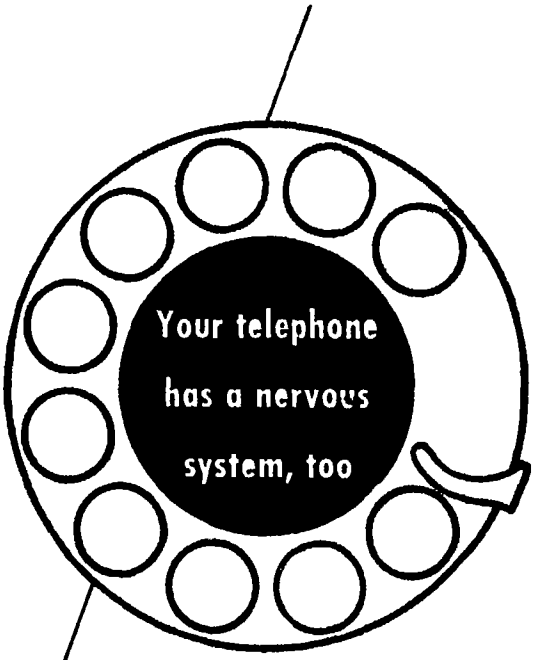
MODERN MILLS — "In the new Prescott Mills, Lowell, the rooms are all heated with hot water pipes, and hot and cold water are constantly supplied to the hands by means of pipes when required for washing or cleaning The rooms are large and airy, the looms are propelled by steam, and this is the only mill in the city where steam power is used for weaving."

BLASTING — "It was stated by Mr Mould, on the occasion of the opening of the Lancaster and Carlisle railroad, that no less than 4800 barrels, or 200 tons of gunpowder has been used in excavations on that road"

CASTING — "Jagger, Treadwell & Perry of Albany, made one day last week for Messrs Corning, Horner, & Winslow's new rolling mill, a casting which weighs twelve tons. It was the rim of a wheel—the arms of which will weigh six tons—making eighteen tons for the wheel"

RUBBER BOATS — "The War Department has sixteen factories employed in working Goodyear's patent India rubber into pontoon boats and other military articles. These boats or floats, though light and portable, are capable of carrying sixteen men each"




Your telephone has a nervous system, too

WHEN you spin the dial of the latest type of telephone system—known as "common control switching"—you order into action a giant nervous system It sends electrical impulses through an intricate maze of circuits more than 10,000 contacts can be opened or closed in a single dial call

This system takes your order, remembers it, translates it into its own electrical language, throws out sensitive "feelers" to find a through route, plans how to make the connections, makes them, puts through the call—and, if the preferred paths are busy, finds an alternate route to take the call

The complex art of telephone switching is brought to a high state of development at Bell Laboratories to serve the Bell System Some day through "common control switching" a dial in San Francisco may set up a connection through to a subscriber in New York

■

Left. Backstage on your dial telephone call—some equipment in a typical "common control switching" office.

Bell Telephone Laboratories

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED ECONOMIES AND IMPROVEMENTS IN TELEPHONE SERVICE

Previews of the Industrial Horizon

By A. P. Peck

MACHINES DO MAKE JOBS

Even today, despite ample proof to the contrary, there are people who still feel that technological advances result in unemployment; that new machinery and more efficient tools throw men out of work. Disregarding the temporary and short periods of local unemployment which can follow replacement of manual labor with machinery, a few facts will serve to point up the true situation. For example: A hundred years ago the average weekly wage of American workers was less than $5 while the investment in machinery for their use was less than $500 per employee, today the average wage has climbed more than 1000 percent and the investment per worker has increased to $7000

Results can first be exampled in dollars Thus, an automobile tire cost about $50 a quarter of a century ago; today a tire that will give ten times more mileage can be bought for half that price. Again, electric light bulbs that cost 60 cents or more only a few years ago can now be purchased for 10 or 15 cents

But dollars do not tell all the story New machines, new methods, new tools make it possible for more people to be employed because, through these technological advances, the workers can turn out more and better products at lower cost, thus enabling more people to become consumers. More products, more consumers, more workers, more products . . . it's an endless chain.

This whole problem of machines *versus* employment is neatly summed up by A. M. Sargent, president of the American Society of Tool Engineers, in the following statement: "Tool engineering, coupled with top-efficiency machines, are the only levers which can further increase our national income While accomplishing this goal, they will continue to lower consumer prices and step up employment, yet yield a satisfactory profit to stockholders . . . for such a system invariably encourages production."

ENERGY FROM NUCLEAR FISSION

Powerful electrostatic forces which bind atoms together may someday be utilized in the direct production of electrical energy for industrial uses. This is the opinion of John G Trump, Associate Professor of Electrical Engineering at Massachusetts Institute of Technology. Pointing out that most present plans for utilizing nuclear energy involve heat and heat engines, Mr Trump predicts that perfected electrostatic machines "may be uniquely able to utilize directly the energy of nuclear fission without the intermediate heat cycle."

BIG ONES FROM LITTLE ONES

Laminated wood beams, while not exactly new as structural units, are currently offering new use for scrap lumber. Such beams, properly designed and put together with the correct adhesive, can utilize a lot of the 60 percent of every felled tree which is now waste—burned as fuel or simply discarded. They are made with good clear lumber on the outside only; the inside of the beams may be filled with lower grade wood, even with scrap Despite this seemingly "jerry-built" construction, the resulting laminated beams are stronger than beams of similar size sawn from straight, sound—and therefore relatively rare—trees.

Answer to the strength of these composite beams is two-fold: Modern adhesives can be made stronger than the wood itself, by placing the grains of the pieces which make up the beams at angles to each other, stresses can be spread over the entire beam instead of being concentrated

MOLY AT WORK

Significant to high-temperature fields—such as internal combustion engines, jets, rockets, and electrical circuit breakers—is the recent development of a process of producing ingots of molybdenum weighing more than 150 pounds. Moly, with a melting point only a little under 5000 degrees, Fahrenheit, has up to now been one of the bad boys of metallurgy. However, because of its corrosion resistance and good wearing qualities at elevated temperatures, moly has offered a challenge to research which appears to have been successfully met. Production details are still held secret

BATTLE OF THE MOTOR CARS

Biggest industrial disappointment to the public has been the failure—on the surface—of the motor-car manufacturers to live up to the glowing promises of post-war vehicles that would be out of this world in performance, appearance, and price But under the surface—and quite aside from the familiar problems of materials and labor—there is a real struggle going on that should redound to the public's benefit within six months after these lines appear in print

Ford is going after General Motors' leadership and, it is reliably rumored, will have a real "Car of Tomorrow" on the market before the end of 1947. Outstanding innovation, it appears, will be an extremely simple automatic transmission which will be inexpensive to manufacture.

But don't think that General Motors and others will take a licking without fighting back. They *will* fight And John Q Public, along with the entire motor-car industry, will profit by this competition.

STRAWS IN THE WIND

Whiskey may become a by-product of the distilling industry; present wastes are high in potential value as live-stock feed. . . Improved anti-knock gasolines will give 50 percent more mileage. . . A vinyl resin plastics is challenging linseed oil as basic ingredient of linoleum.

14 MAY 1947

Scientific American
APRIL • 1947

Tough Alloys Cut Like Cheese

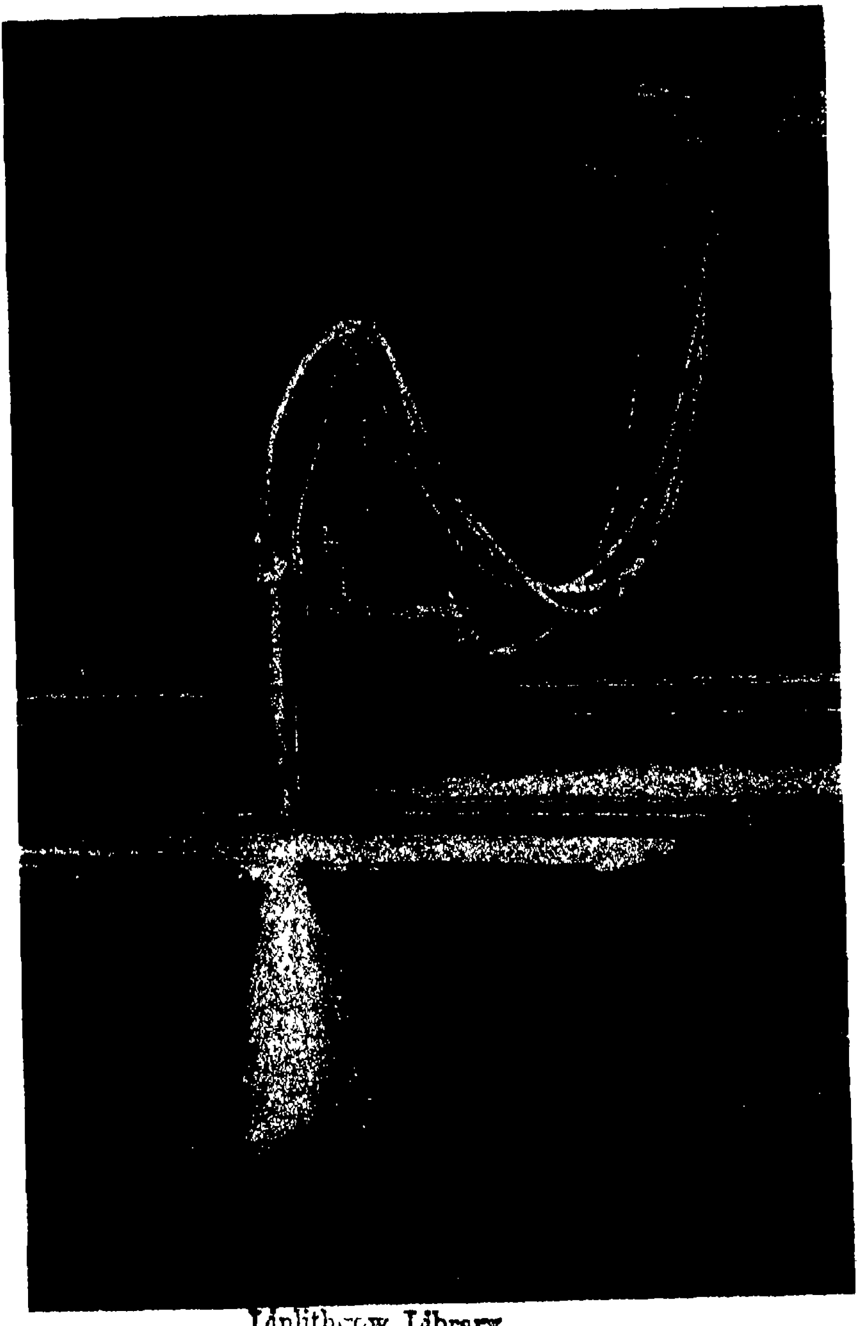
Until Recently, All Attempts to Apply Conventional High-Temperature Cutting Techniques to the More Refractory Metals Resulted In Slow, Ragged Cuts Now, However, With Newly Developed Methods, Many of These Metals Can Be Cleanly Cut on a Real Production Basis

By FRED P PETERS
Editor in Chief *Materials & Methods*

THE PAST 15 years have witnessed remarkable advances in the cutting of metals at high temperatures Oxyacetylene cutting (also called the oxygen lance) and carbon or metallic arc cutting have been applied to hundreds of different metal shearing, piercing, cutting-off, scarfing routing, and shaping applications in sheet and plate metal shops, foundries, steel mills, ship yards, construction jobs, and so on The process has been mechanized and pantographed, subjected to wizard-like electronic control, applied to the cutting of stacks of sheet in one operation, and employed to cut metal underwater

Most high-temperature cutting, however, has been applied to plain carbon steel and a few other non-refractory metals For these, the process—primarily one of rapid oxidation of the metal being cut along a thin line—has been ideal because the melting temperatures of the oxides formed are lower than the melting points of the base metals used. In such situations, the iron oxide, for example, melts off as fast as it is formed and, if anything, helps rather than hinders the operation.

Attempts to cut more refractory materials such as stainless steels, Hastelloy-type alloys, aluminum bronzes, and so on usually came to grief (or at best were slow and produced a ragged cut) because the oxides formed were pasty or even solid in the reaction area, and protected the base metal against further oxidation as fast as they were



Right Linde powder-cutting torch making a cut in a one-inch stainless steel plate

Linlithgow Library.
Imperial Agricultural Research Institute,

The Arcos cutting tool ready to pierce a heavy piece of alloy steel

• LOOKING AHEAD •

Many alloys finding wide application in places from which their cutting difficulties had formerly barred them . . Cost-cutting fabrication of these metals. . Greater efficiency in many construction jobs, with the better materials more readily available

formed Continuous cutting was thus virtually impossible and, to carry out the operation at all, much preheating of the metal and very slow passage of the oxyacetylene flame or the cutting arc were required.

Within the last year, however, three new and different processes for rapidly cutting stainless steels and other tough alloy materials have been developed and placed in use Engineers and fabricators who are using them are glowingly enthusiastic and believe that, in addition to simplifying and lowering the cost of established stainless steel fabrication, the new processes will open to stainless steel many applications now denied to it because of the previous difficulty in rapidly making clean cuts in the material

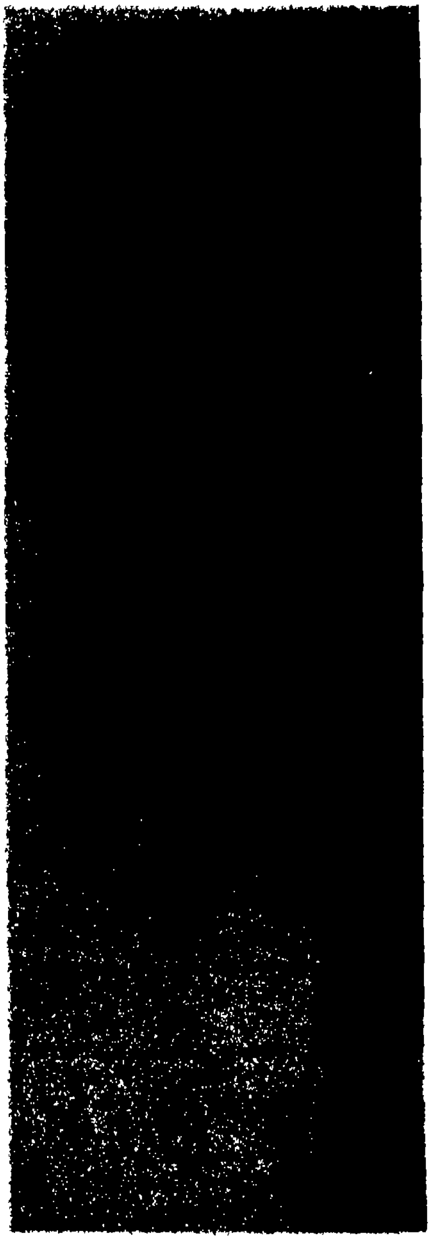
The three companies who have developed these new processes are Linde Air Products Company (a division of Union Carbide and Carbon Corporation), Air Reduction Company, and the Arcos Corporation The three processes have one principle in common the fluxing away of the high-melting oxides produced, either with molten iron, molten iron oxide, or an inorganic salt

POWDERED IRON USED—Linde's process is called the powder-cutting method, and uses a finely divided iron (or iron-rich) powder, which is ejected into the oxygen stream and burned, the resulting high-temperature reaction cuts the material The iron powder is heated to ignition temperature by the oxyacetylene flame The equipment comprises a powder dispenser and a powder blowpipe, especially designed to feed the powder into the oxygen stream Machine-cutting attachments are also available so that standard oxyacetylene cutting equipment can be adapted to powder cutting.

In the method developed by Air Reduction, specifically for stainless steel, a chemical flux is fed through the oxygen stream of an oxyacetylene torch to react with the refractory oxides of chromium and nickel These oxides are thereby fluxed away and cutting can proceed apace

The third method, developed by Arcos, is called the Oxyarc process and uses a fine-point concentration of heat generated by an electric arc and a stream of oxygen. The arc is established between a coated tubular mild steel rod (consumed in the operation) and the metal being cut. The oxygen flows through the tubular cavity in the rod, and the still-reacting molten rod-metal literally cuts its way through the material being fabricated

THICK SECTIONS CUT — The Linde powder-cutting process seems to have no upper limit on the thickness that can be cut, 26-inch sections having been successfully cut to date For sections smaller than ¼-inch, however, stack cutting is desirable if maximum quality of cut is sought Tight clamping is not necessary when stack-cutting with the powder process, because the high heat of the reaction easily jumps across gaps between the plates



Drawing of the Arcos cutting rod

Iron powder burning in an oxygen stream slices through an alloy plate

Cutting speeds with the powder process are good On a one-inch stainless steel plate the cutting speed is 14 to 16 inches per minute, on ½-inch stainless the speed is 20 to 24 inches per minute At the other extreme, a 20-inch stainless steel section can be cut at two to three inches per minute These speeds are comparable to those attained in oxy-acetylene cutting of plain carbon steel

In addition to its many stainless-steel applications, powder cutting has also been used for removal of risers prior to sand-blasting in carbon steel foundries, for cutting cast iron, and on some high-alloy steels and certain nonferrous metals Costs are difficult to estimate at present because of the variety of conditions encountered In general, however, powder cutting of stainless steel costs about twice as much as ordinary oxyacetylene cutting of an equivalent-size carbon steel job, the powder amounts to 25 to 50 percent of the total cost. Powder cutting of cast iron is just about twice as expensive as powder cutting of stainless steel, because the cutting speed for cast iron is about half that for stainless

The Linde and Air Reduction processes appear to have their greatest economic utility in stainless-steel producing plants and foundries, although the powder cutting process is being used increasingly for shape cutting of stainless steel in fabricators' plants and for such other materials as nickel, Monel, Inconel, Hastelloy, and so on.

Typical of the applications the powder cutting process has received are the scarfing of stainless-steel ingots, cutting off hot tops from ingots, removing risers from stainless steel castings, and so on For example, a six-inch diameter riser can be removed by powder cutting in one and one-half minutes overall time, whereas the same riser removed by the old carbon-arc process would require 25 to 30 minutes cutting time The process is also used for shape-cutting stainless-steel sheet, beveling plate edges, and for grooving out weld defects

ARC PLUS OXYGEN—The Arcos Oxyarc process was originally developed by an Arcos Corporation affiliate in Belgium, where it was used for war-time cutting of mild steel It is in many respects an adaptation of the American Navy's underwater cutting method employing an electric arc-oxygen stream The tubular rod used is coated, 18 inches long and 3/16 outside diameter, and is made of mild steel The rod coating helps to maintain arc stability and forms a small crucible which directs and confines the arc It also acts as an insulator to prevent striking the arc at any other point except the end, and serves as an "insulated heel" on which to drag the rod along the line of cut.

At the present time the Oxyarc process is economically advantageous for cutting thicknesses up to three inches and for piercing up to 12 inches It is a distinctly general purpose alloy-cutting process, being especially useful on thin-section work and for the scores of odd cutting jobs continually arising in sheet metal fabricating plants. As with the other processes, speeds are a function of the material and its thickness, ranging for example from two inches per minute for two-inch cast iron up to 23 inches per minute for quarter-inch copper

As to costs, it has been found that 18 to 22 percent of the cutting costs with the Oxyarc process is labor, 65 to 72 percent is the cost of the rods, and the remainder is oxygen and electricity The Arcos Corporation has provided the accompanying table which gives the speeds and costs when using the process on different materials.

The widest application for the oxygen-arc process is in cutting alloy steels, particularly stainless Other metals which have been successfully cut include nickel, Monel, copper-nickel, aluminum, copper

The Oxyarc process, employing an electric arc supplemented by an oxygen stream, is another method of cutting many hard-to-cut alloys quickly and accurately

Cutting Speed and Costs for Oxyarc Cutting

MATERIAL BEING CUT	THICKNESS, INCHES	CUTTING SPEED IN PER MIN	TOTAL COST PER FT OF CUT (LABOR AT $1.50 PER HR)
Aluminum	⅜	15	$0 12
Monel	1	2 7	0 68
Hastelloy B	⅜	9	0.25
Bronze	1	3 3	0 43
Copper	¼	23	0 13
Stainless Clad	⅝	22.5	0 12
Cast Iron	2	2	0 71
Nickel	½	5 5	0.24
Stainless Steel (type 347)	¼	10	0 15

alloys, cast iron, and plain carbon steels Clad materials such as stainless-clad and nickel-clad steel are readily cut The process is also applicable to stack-cutting, especially for thin plate, and no clamping is required even though the plates in the stack be separated by as much as ⅛ inch

Applications have been reported for the Oxyarc process ranging from those in small job-shops to large metal-fabricating plants Savings of time and money have been scored in the fabrication of complicated shapes where holes for flange connections, manholes, and so on, must be cut in the part after forming For example, in the construction of a five-foot diameter stainless-steel tower four holes—two four-inch diameter and two two and one-half-inch diameter—were cut in the side of the structure in 15 minutes This job would have required 24 man-hours by the usual method of drilling and chipping out similar holes with a hand chisel

AVOIDS LAYOUT — Layout of sheet and plate for fabrication is a time-consuming operation in many industries Using the Oxyarc process as a rapid means of making cut-outs after the part is formed, the complicated layout before forming can often be eliminated Another interesting use of the process is for rapidly piercing carbon steel to provide a starting point for an ordinary oxyacetylene cut, when the cut is not designed to start at an edge Other special advantages are the process' thin rod, which provides a means of cutting in places that are inaccessible to the regular torch, and its special utility in cutting through pipe from one working position and without turning the pipe

All these processes are new, and further developments and improvements in them are foreseeable But already they have demonstrated not only their cost-cutting advantages, but also their ability to extend widely the applications of some of our tougher alloy materials

* * *

GALLIUM THERMOMETER

Measures High Temperatures Directly

A THERMOMETER has recently been developed for use in the metal, ceramic, and similar industries whose operations involve temperatures around 1000 degrees, Fahrenheit It consists of a quartz capillary tube inside a quartz envelope, the capillary is filled with pure gallium (containing a slight trace of iron), which is liquid above 100 degrees, Fahrenheit The new thermometer can be used (just as a mercury thermometer is used for ordinary temperatures) for direct temperature readings up to 1200 degrees, Fahrenheit, and is intended chiefly for the range of 950 to 1000 degrees, Fahrenheit—temperatures which could otherwise be measured only with thermocouples, optical pyrometers, or other "indirect" means

FLAT WIRE

Cut from Centrifugally-Cast Metal Disks

A MAKER of metal screening from copper and its alloys has developed a novel method of making flat wire of brass, phosphor bronze, and nickel silver, which may well be followed by others. The molten metal is cast centrifugally into thin disks. Then cutting machines snip off the flat wires from the outer edges of these disks Advantages are sounder metal, free from flaws and gas holes, hence with lower scrap loss. The three metals used do not require heat treatment

BRIGHT PLATING

With Cyanide Copper Is Fast and Inexpensive

THROUGH the development of a new bright copper plating process, it is now possible economically to copper-, nickel-, and chromium-plate zinc die castings and other metal parts without any intermediate buffing operations The process, developed by MacDermid, Inc , employs a simple cyanide copper bath containing a proprietary brightener, and functions over a broad range of operating conditions

Zinc die castings are said to be electroplated more successfully by this process than by any other The denseness of the copper deposit obtained minimizes the appearance of black streaks during subsequent nickel plating of these parts

Reasonably high plating speeds are obtained with the new process For example, at 20 amperes per square foot, a commonly used current density, a 0 001 inch copper plate can be deposited in one half hour Modifications in bath and practice can be employed to achieve even higher speeds Costs are described as extremely low, the low rate of cyanide breakdown more than off-setting the cost of the addition agents

A special feature of the solution is its ability to plate smooth deposits even in comparatively dirty solutions Others are its adaptability to simple steel tanks and other conventional equipment, and the fact that any conventional copper anodes can be used with it

FINE STEEL WIRE

Being Produced to Close Tolerances

STEEL wire today is an even more important raw material than in former years Great quantities of fine wire are now produced to tolerances of ±0 0002 inch, some of it with tensile strengths above 300,000 pounds per square inch

An important current application is the use of 0 0059-inch diameter wire in heavy duty tires, to provide a core for the bead holding the tires on their rims Another war-time development which is here to stay is the availability of a high-grade American valve spring material, which before the war could be obtained only from Swedish manufacturers

Batching by Electronics

Overcoming Many of the Limitations of Purely Mechanical Counting Methods, Electronic Devices Can Sort Count, Batch, and Totalize at Speeds as High as 15,000 Units per Minute with Incontestable Accuracy

By VIN ZELUFF

Associate Editor *Electronics*

• LOOKING AHEAD •

More economical packaging through elimination of short- and over-counts Precise control of processes involving large numbers of identical parts Electronic "memory" units which keep tabs on groups of machines operating at different speeds

MODERN high-speed machines are inefficient when the methods used in batching, sorting, filling, and packaging do not keep pace with the output of the machines Then, to keep production in step with the processing machine several operators are required to handle the product, fill containers with the proper quantity, or do other costly hand operations

In some plants, such old-fashioned methods as the use of hand scoops and ratio weighing are used as a volume or weight indication of quantity, for small items such as pills, buttons, washers, and bolts With hand scoops consumer dissatisfaction is frequently caused by the inaccuracy which results in a short count On the other hand, prices are often pegged higher than necessary to offset such possibilities because the manufacturer adds about 3 percent overage to insure a minimum correct count in the finished package

Ratio weighing—the use of a fixed quantity to determine by scales the count contained in a larger weight —may also be inaccurate and costly when variations occur in the density of the sample Objects which absorb moisture, as well as stamped metal parts where the gage of the metal stock is not held to close tolerances, are particular offenders in this respect

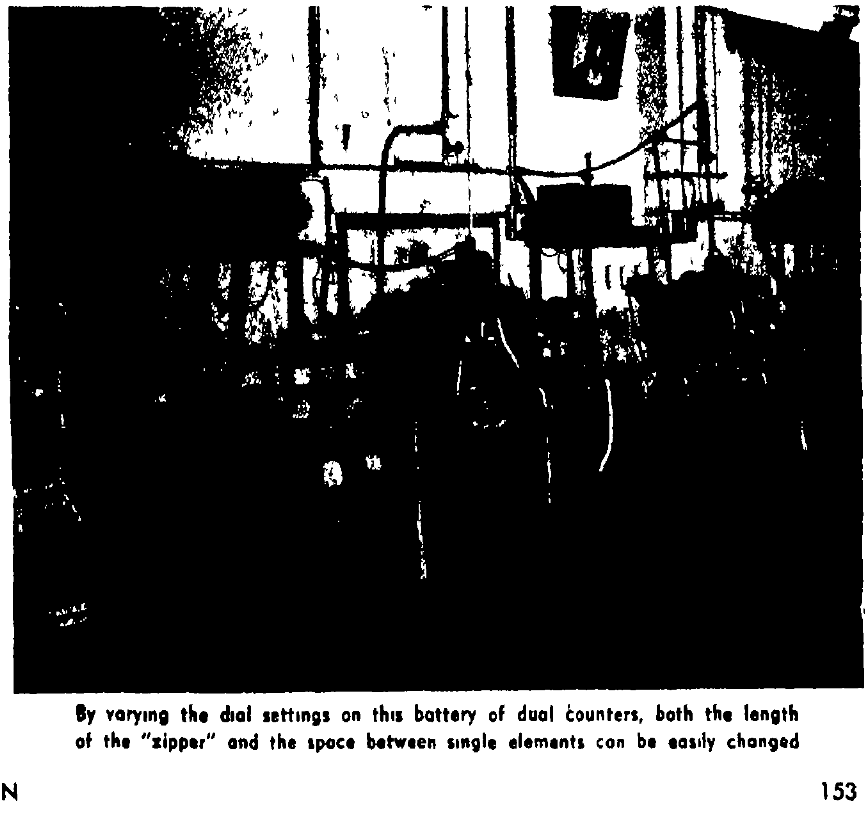
A partial answer to this problem is the use of mechanical counters These are usually limited to a maximum speed of less than ten per second and have the additional disadvantage that they are frequently actuated by the operation of a machine part rather than by a processed item Thus the counter continues to register even if the machine runs out of stock or fails to operate correctly

HIGH-SPEED COUNTERS — Pre-set electronic counters are now finding wide usage in high-speed packaging and sorting applications, as well as in high-speed manufacturing processes which require split-second actuation of controls This type of counter is being used in control of tin-plate processing, the manufacture of "zippers," packaging of many different types of small items, and hundreds of other industrial applications

With the electronic counter, counting, sorting, or grouping for packaging any small or large items can be done at rates up to 15,000 per minute in pre-set quantities from 1 to 10,000 or more pieces Pills, buttons, screws, washers, caps, sheet steel, machined parts, and even liquids can be batched in this manner

One of the drawings shows how a pre-set counter is used to count a definite number of pills and accurately channel the quantities into two lines of bottles on a moving conveyer belt Pills to be packaged are placed in a hopper and are fed to a rotating disk and belt arrangement which is designed to emit pills in single file at rates of approximately 250 per second As each passes through the light beam it causes an electrical impulse to be injected into the input of the pre-set counter

The electronic circuit of the counter is set by means of dials to actuate a self-contained high-speed single-pole double-throw relay each time the proper count is reached Thus if the quantity of pills required in each bottle or box is 100, the output of this relay actuates a solenoid which moves a deflector plate and thereby channels the pills in quantities of 100 alternately through two



By varying the dial settings on this battery of dual counters, both the length of the "zipper" and the space between single elements can be easily changed ducts The conveyor belt carries the empty bottles in two lines to gates which are directly under the ducts These gates are actuated alternately by the same impulses that control the deflector plate When the bottle has been filled with the correct quantity of pills, the respective gate is opened and the bottle is permitted to travel along the conveyor to the capper Meantime a second bottle is filled and the operation proceeds

FROM ONE TO NINE

— The basic unit of the pre-determined counter is a four-tube electronic counting circuit that registers a count from 1 to 9 on neon bulbs and then resets to 0, and provides one electrical output pulse for every 10 injected This is accomplished in a binary progression using a 1-2-4-8 series

The complete counter contains four such circuits in tandem, four switches for setting the count, and an electronic switch which is used to actuate a relay By using the four circuits, a count of 0 to 10,000 can be arranged simply by setting the four dial switches, each having ten positions numbered 0 to 9 These are set by subtraction from 10,000, the maximum count obtainable In the case of the pill counter, the count of 100 is achieved by setting the dial switches to 9900 When the counter reaches 10,000 the output relay then operates

The dial switches make connections to the proper grids of trigger tubes, for injection of the pulses needed to give a pre-set starting count For automatic repetition of the count as used in putting pills into bottles, the pre-set combination of pulses is applied automatically at the end of each count to the common terminals of all switches For some operations, manual starting of the cycle is required and a button is located on the front panel for this purpose

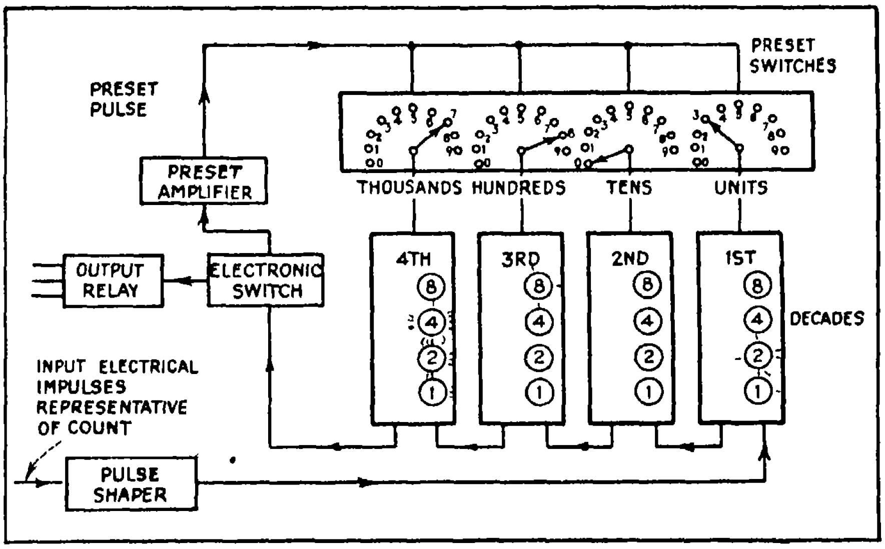
When automatic pre-set is used, the output pulse from the last circuit triggers an electronic pulse generator which supplies a positive pulse to the required tubes for starting a new count, as determined by the setting of the pre-set switches

All types of operations and processes requiring split-second control can use this pre-set counter The electrical input impulses can be produced by shaft rotation, the interruption of a photoelectric light beam, reciprocating member motion, contact closures, electromagnetic field disturbance, and many other actions which are representative of counts The fast-acting output relay can readily be adapted for solenoid control

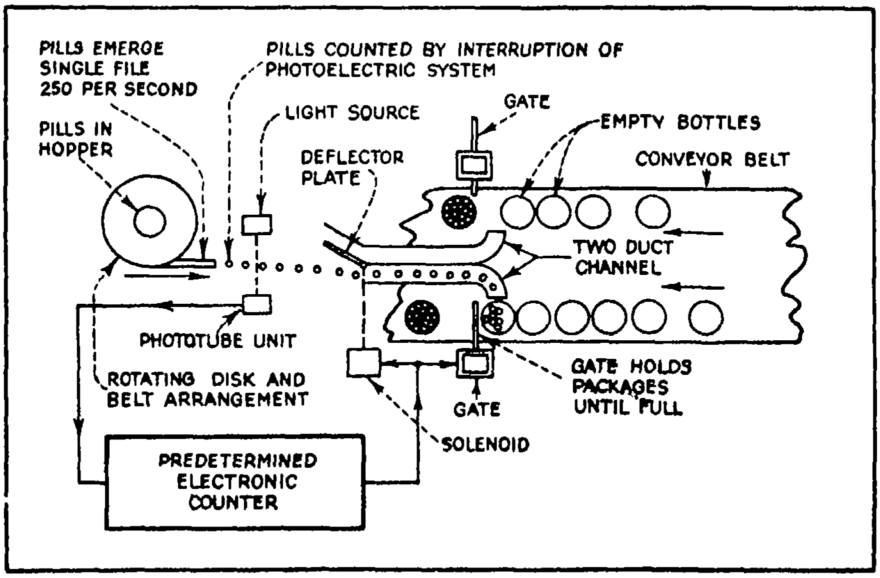
Double counters may be used for controlling processes which consist of two different operations An example of this type of application is high-speed control of "zipper" manufacture Here accurate control of the number of metal elements and the spacing between groups of elements inserted in the continuously moving tape is required These two operations are normally controlled by cams or gears, which frequently cause errors and limit the maximum speed of operation

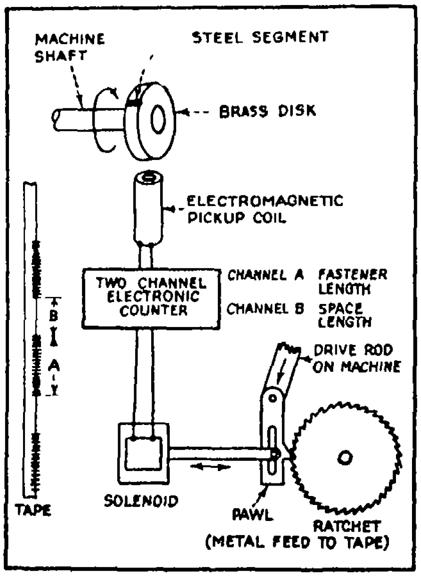
SUBSTITUTE FOR CAM

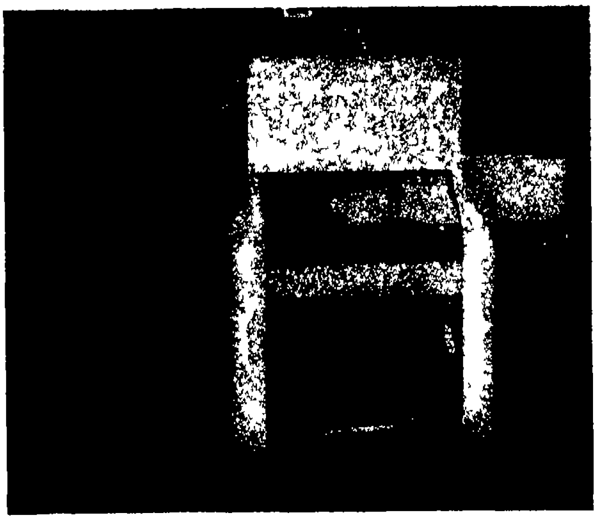
— The double counter provides alternate switching of the output relay at the completion of each of two different pre-determined counts and it can be readily substituted for the cam or gear control in this application In practice, the number of "zipper" elements desired is set up in one channel of the counter by means of the dial switches, and the spacing between groups of elements set up in the other counter channel by means



The diagramed four decade single pre-set counter (above) is set for a starting count of 7803 as required for batching 2197 units Also diagramed are the mechanical and electronic features of pre set counters as applied to pill-packaging machines (lower left) and to slide fastener machines (lower right)


PILLS EMERGE SINGLE FILE 250 PER SECOND
PILLS COUNTED BY INTERRUPTION OF PHOTOELECTRIC SYSTEM
PILLS IN HOPPER
LIGHT SOURCE
GATE
EMPTY BOTTLES
DEFLECTOR PLATE
CONVEYOR BELT
TWO DUCT CHANNEL
PHOTOTUBE UNIT
ROTATING DISK AND BELT ARRANGEMENT
GATE HOLDS PACKAGES UNTIL FULL
GATE
SOLENOID
PREDETERMINED ELECTRONIC COUNTER





The pre set electronic counter enables the pill packaging machine to bottle up to 15,000 units per minute with absolute accuracy

Courtesy Potter Instrument Company

of a second row of dial switches The electrical input to the counter is derived from a shaft rotation which corresponds to the insertion of a "zipper" segment or to an equivalent space on the fastener tape

Conventional "zipper" machines require the changing of gears or cams each time a new length is desired The double counter eliminates this time-consuming operation To change "zipper" length with the electronic control it is necessary only to change the dial switch settings This can be accomplished without stopping the machine Normally this model controls at rates up to 12,000 per minute Equipment suitable for higher rates of operation is also available For accurate counting at high speeds, standard electronic counters will operate at rates up to a million per second in response to interruption of a photoelectric light beam or other form of actuation

The counting device can also be used as an interval timer In this case, a crystal-controlled oscillator is fed into the counter by an electronic switch which is operated by the initiating and terminating pulses from a time interval If a 100-kilocycle quartz crystal is used as the standard, the accuracy of measurement will be 0 and —10 microseconds for an interval as long as desired Interval timers of this type are now used by the armed services for projectile velocity measurements Pre-set interval timers using the same principles are also being supplied for the generation of precise time intervals

TOTALIZING POSSIBLE — Development of the basic electronic counter principle has resulted in an instrument which is capable of totalizing the individual outputs of many sources occurring at random times This system has been applied to a pari-mutuel betting machine at a race track for recording the amount of money bet on each horse at the ticket machines Since this equipment must also convert the $2, $5, $10, and $50 bets into equivalent dollars for totalizing, it was necessary to develop circuits which would add and multiply electronically Such totalizing equipment is useful in a manufacturing process where many machines are making the same product at varying rates In this instance, it is often desirable to know the total output or the average rate per machine The totalizing equipment can be readily used for this purpose even where the outputs occur at random rates and counts occur simultaneously

Newspaper plants can use this system for obtaining an up-to-the-second count of the various press outputs It can also be used to record total fluid output by totalizing the outputs of the individual flowmeters Power-plants can use such a device for recording the total output from several generators by totaling the readings of individual wattmeters These are but a few of the thousands of possible applications of totalizing equipment

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FOUNDRY CORES

Baked Uniformly by Electronic Method

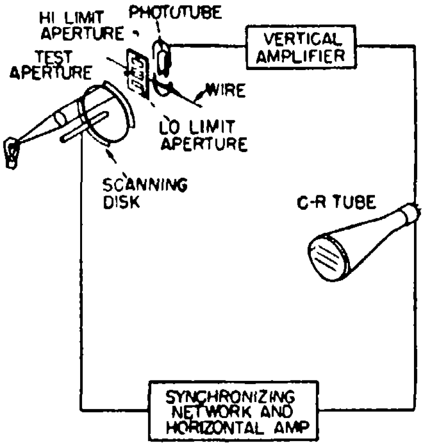
ELECTRONIC heating has reduced to 30 seconds the baking time for foundry sand cores that required hours of time by the old oven method The wet cores are now carried through a dielectric heating tunnel by belt and timing is thus removed from the responsibility of the operator It is impossible to burn the cores even by repeated passes through the tunnel Cores are uniform, with ideal color and texture, whereas oven-baked cores were irregular in texture

It has been found possible to pour Alnico and Stellite around cores produced by the electronic process The reported cost for power is about $1 25 per ton of sand treated and tube cost is eight cents per hour The equipment used is made by Induction Heating Corporation

CONTINUOUS WIRE MEASURER

Checks High and Low Limits By Shadow on Tube

AN ELECTRONIC micrometer for thin materials speeds continuous-production measurement of wire diameter and strip thickness by using a phototube to measure the shadow of the material under observation Significant savings are claimed when the instrument is used in the manufacture of plastics-covered wire, razor blades, rod, bar, and tube stock and coated or bare filament wire



Using light to shade ratios as a guide, tolerance can be checked to 0004 inch

A measuring head contains an aperture across which is fed the material to be measured This is illuminated by a lamp that casts a shadow of the object on the cathode of a phototube located behind the measuring aperture The area on the surface of the cathode that is not in a shadow produces a voltage signal in the phototube

Two other openings, one on each side of the measuring aperture, represent the positive and negative tolerance limits to which the material must conform

A scanning disk rotates between the phototube and the apertures, exposing each of the three in sequence so that the signal level changes only in proportion to the tolerance of the material under measurement and does not change with respect to the absolute dimension of the material The sensitivity of the instrument developed by Wilmotte Manufacturing Company, is such that it is possible to measure dimensions in ranges up to 0.6 and up to 0.005 inch, in both cases within an accuracy of 0.0004 inch.

EMERGENCY CONTROL LINE

Uses Commercial Channels For Signal Impulses

Should flood or storm knock out railroad switching or signaling pole lines, the commercial message channels could be used to actuate the vital equipment. In a recent test, the Pennsylvania Railroad successfully used an emergency 900-mile link that replaced a 53-mile wire line from a traffic control tower near Red Bank, Pennsylvania, to Oil City, Pennsylvania. For the test, the impulses were flashed from the Red Bank tower to Pittsburgh over Pennsylvania Railroad wires, then via Western Union wire and cable circuits to Washington and Philadelphia. A Western Union radio beam circuit carried the impulses from Philadelphia to New York, and they returned to Pittsburgh over telegraph wires. Transmission was over railroad wires back to the control tower, when the impulses entered the regular wires to throw the switches and set the signals.

ELECTRON-BEAM COMPASS

Serves Also As Magnetometer

Capable of precise readings unattainable with conventional magnetic compasses, a west-seeking compass uses an electron beam which is focused at four target plates in a special vacuum tube. The beam is equally divided between the plates when pointed in the direction of the earth's magnetic field. In any other position, the earth's field bends part of the beam so that it strikes the targets unevenly. Combined with an electronic amplifier, the instrument, a product of the Minneapolis-Honeywell Regulator Company, measures the different electron currents on the plates and then translates the difference into energy sufficient to move indicator needles or to control the auto pilot used in aircraft. It will also be possible to use the instrument to control ships automatically, and as a magnetometer in prospecting for oil, ores, and other subterranean deposits.

INVISIBLE TALKING

Made Possible by Use of Cesium Lamps

When there is urgent need for communication between two points several miles apart, yet wire lines are down and radio cannot be employed for reasons of secrecy, a new talking lamp developed by Westinghouse steps into the picture. This cesium vapor lamp (see also page 28, January 1947 Scientific American) alternately dims and brightens thousands of times a second when connected to an amplifier and microphone. The resulting strong yet invisible beam of infra-red light can be picked up by a phototube several miles away and converted back into sound by a conventional amplifier and loudspeaker.

Infra-red beamcasting is unaffected by static, and gets through in all weather except extremely soupy fog or smoke. It has possibilities for conversations between planes flying in formation, where radio equipment on board is needed for other purposes, and has maintained contact between ship and shore even during high-speed maneuvering. Although developed too late for use in combat in World War II, it is now ready for future use by the Navy in convoy duty and for issuing troop landing instructions immune from jamming or eavesdropping.

No static, jamming, or eavesdropping

ELECTRONIC TRAINING PLANE

Simulates All Air Maneuvers, Incorporates Complex Instruments

Flight characteristics of an AT-6 airplane in the air are simulated by a new electronic flight trainer, complete with automatic radio range.

A complex electronic computing system solves differential equations expressing the motion of an airplane in space and is the basis of the unit.

All the interacting effects between lift, drag, thrust, and the various other moments and forces causing the airplane to maneuver, stall, or spin in space are developed as electrical voltages when the controls are operated. These voltages are sent as signals to the computing system of the trainer, which delivers the correct answers and translates them continuously and smoothly into instrument indications in the cockpit of the trainer, into variations in engine sound effect and control loading, and into actuation of the course-plotting unit and radio-navigation aids.

In appearance the Curtiss-Wright Dehmel trainers resemble a single-seat airplane fuselage, minus wings and tail section. Because it can be adapted to the instruments and flight characteristics of any type airplane, the trainer offers many possibilities in the field of flight training. By alteration of the components of the electronic computing system and insertion of the appropriate instrument panel in the dummy cockpit, changing requirements of new types of aircraft can be duplicated in the trainer accurately and satisfactorily.

Computer reduces motion-in-space to readings on trainer's instrument panel

Chemists Fight for FOOD, FORAGE, FIBER

How Can Full Use be Made of Available Agents for Protection of Crops Against Destruction by Insects and Disease? Can Government-Sponsored Research Give the Answer?

By D H KILLEFFER
Chemical Engineer

WITH ALL of today's modern improvements and with all the new things available for our bright new world, we are still curiously anxious to seek out more novelties, although we are yet far from fully utilizing many of those we have had for several decades We are ready to embark upon weighty and protracted researches to be subsidized by us through our government and to be directed toward laying more and greater potential blessings at our feet when we have done practically nothing about a number of those already in our possession That is the serious charge made against the people of the United States by the industry which produces agricultural insecticides and fungicides

That industry has spoken out boldly about the directions which research of the future should take to accomplish the greatest good for the greatest number It has also called upon all concerned with the production of food, fiber, and forage crops to utilize fully the chemical weapons already available to us in conquering the pests which now consume and destroy large shares of the output of our agriculture While any other industrial group might well have made such charges, the universal dependence of all of us on agriculture and on the efficient production of crops gives this industry's charges particular pertinence

PENETRATING SURVEYS — The need in the field of crop protection today, the industry says, is for penetrating surveys of pests, which can be supplied only on a far broader basis than is possible through the investigations of any small group or aggregation of such groups The industry already possesses facilities for conducting research into new materials for use in controlling pests and for producing any new agents that may be needed The testing of chemical compounds that may be suspected of having value in crop protection and pest control can be done with reasonable efficiency with no more than enlargement of existing facilities Furthermore, the industry points out, both materials and methods are already amply available to accomplish immensely more than has yet been attempted in the field Thus, the president of American Association of Economic Entolmologists has lately issued a statement to the effect that we already have in our possession means in both materials and methods to eradicate, once and for all, whole families of insect pests He backs up his argument by naming a number of eradications already achieved in this field In the field of methods, the effectiveness of spraying and dusting large areas from the air has reached the point where an acre in a large farm can be treated effectively in two to four *seconds* and at a progressively falling cost already well within reason

• LOOKING AHEAD •

Complete eradication of whole families of insect pests. Doubling of available timber supply "Crop pest attack" forecasts to make victory more sure Co-operative surveys to benefit all American agriculture Chemical industry back of it all

It is worth while, then, in the face of the general clamor for scientific research by government, to take stock of the pest-control and crop-protection problems in order to see which way we should go Their complete solution possesses an economic importance of the first magnitude

The general effect of the war on this segment of the chemical industry has been no less and no greater than elsewhere Research during the war years has provided several important new materials, and the urgency of war demands has hastened the development and adoption of a few new methods Notable among the new agents for controlling pests are DDT, proved effective against many types of insects, 1080, sodium fluoroacetate, powerful rodent poison, 2,4-D, which controls weeds, hexachloro-cyclo-hexane, valuable insecticide, ANTU, alpha naphthyl thiourea, whose value against rodents has been proved dimethyl phthalate, effective against mosquitoes, and a number of other new materials, including the related plant hormones, having valuable properties In the method category are aerosol bombs which effectively atomize liquids or solutions, improved techniques for airplane and helicopter applications of control materials to large areas, and the several varieties of synergetic mixtures in which the potency of the whole is greater than that of its separate parts, these among others Moreover, the industry itself is physically equipped to produce the needed chemicals in satisfactory volume, since it has avoided generally the troubles which grow out of both over-expansion and reconversion from other lines of production

POTENTIAL BENEFITS — Despite this, the situation seriously reflects upon our utilization of these potential benefits Barely one eighth of the acreage in the United States devoted to crops is under protection already proved to be beneficial While it is true that protected crop areas now produce about one third of the total value of our crops, the potential improvement in the productivity of other areas now untreated could be expected to change this ratio by bringing up the value of the output of present low-rate producers This presents a far more lucrative field for research at the general expense than more particularized fields, where industry and scientists, both independent and captive, are already at work seeking new materials

Methods of using insecticides and fungicides have undergone tremendous progressive improvement during recent years The application of these substances and of the plant growth regulators (hormones) to large tracts by airplane sprays, and more recently by the use of slower, but better controlled, helicopters, leave very little to be expected in the treatment of large areas Rates of dusting and spraying by air range up to 20 to 30 acres per minute as compared with a maximum rate of coverage by the fastest modern ground equipment of four to five acres per hour Both methods necessarily have advantages for particular circumstances and both will unquestionably be widely used in the future An important advantage of air-borne treating equipment, particularly hovering helicopters, is the possibility it opens of applying weed killers to the vast stretches of wheat farms, sprays to prevent premature dropping of apples in large orchards, treatment of forest areas to control destruction by insects and fungus diseases, and even the dusting of cattle on the range with insecticides

Clay Lyle, retiring president of the American Association of Economic Entomologists, recently pointed out that advances in both insecticides and methods of using them have already potentially doomed the house fly, horn fly, cattle grub, cattle louse, sheep tick, and others of the same classes "We have the technical knowledge and equipment in each case," he said, "but we must secure a high degree of control through voluntary co-operation before public sentiment will compel final eradication by law "

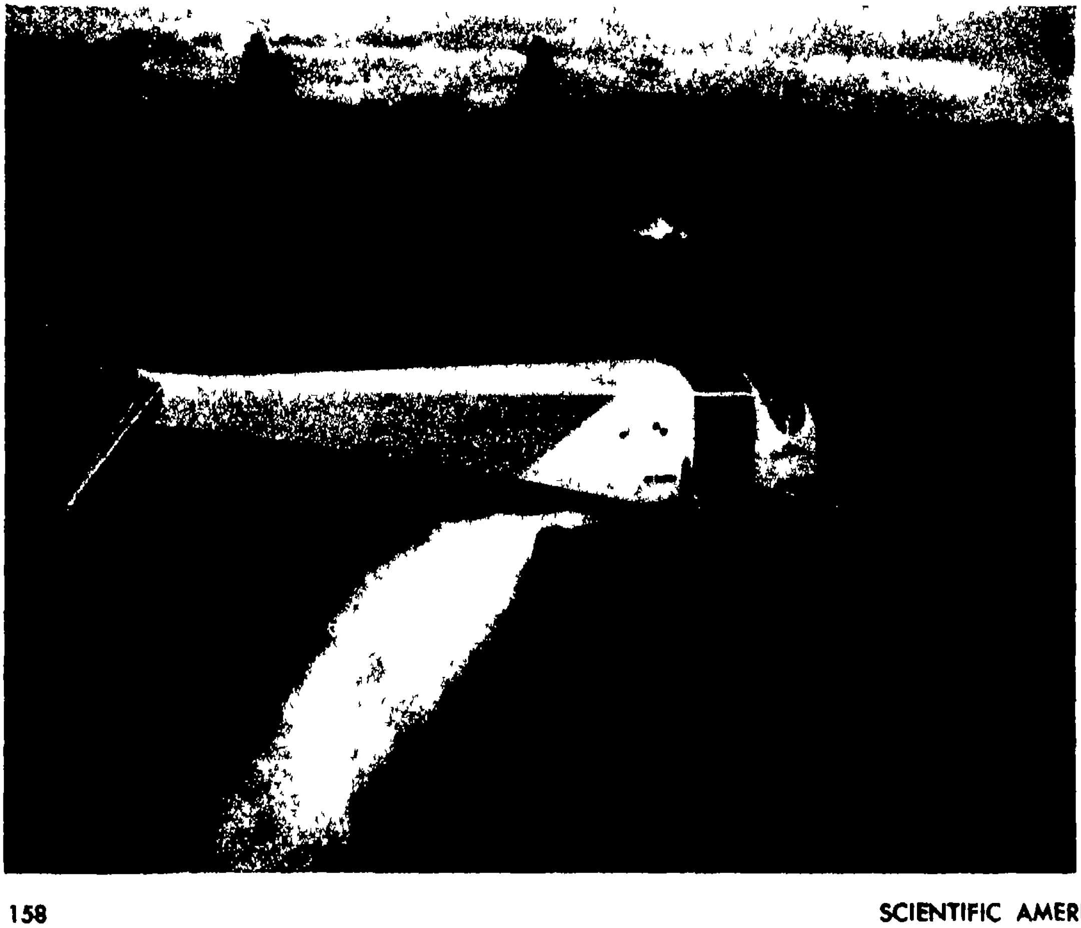
To prove his point, Dr Lyle cited success in fighting in the past the gypsy moth, the cattle tick, date palm scale, sweet potato weevil, citrus white fly, Mediterranean fruit fly, citrus black fly, and the legume weevil Control and near eradication of various types of mosquitoes similarly point to probable success of attacks on other similar pests Results, too, of treating large areas in Zululand with DDT by air suggest the possibility of exterminating the tsetse fly, responsible for the spread of African sleeping sickness, from large sections of Africa, if not indeed from the whole continent

POLITICAL BARRIERS — Dr Lyle further stated that while the eradication of many pests is now technically possible and even simple, political considerations prevent compulsory adoption and use of known measures. Cotton boll weevil could be easily exterminated within five crop years "without much disruption of total production by means of a succession of non-cotton zones gradually extending across the cotton states " But to carry out such a program would require legislation by the several states involved that would compel all cotton farmers to conform to the general scheme Such legislation could not be enacted now and probably could not in the future without tremendous preparation

The great need of all concerned to make full use of available materials and methods for controlling pests and diseases of crops is pointed out by the industry to be a more effective and inclusive reporting and forecasting service The objective is to warn of outbreaks in time to meet them before they become major catastrophes The basic scheme would resemble that now supplying the basic information for weather forecasting Collection of information from all parts of the country to be correlated in a central bureau would soon enable researchers to discern patterns on which forecasts could be based

"Even now a limited amount of forecasting is possible with certain insects," says Dr P N Annand, chief of the United States Bureau

Courtesy Bell Aircraft Corporation



Carrying 400 pounds of dusting powder, a helicopter can treat 4 8 acres per minute Method of application insures that both upper and under sides of leaves are treated protecting forests from insect caused losses greater than those from fire

In large scale tests, spraying five cents' worth of DDT on cattle increased the average production of beef by 50 pounds per animal, in addition to improving the condition of the hides

of Entomology and Plant Quarantine "We can tell fairly accurately, considerably in advance, the population prospects of certain insects grasshoppers, cinch bugs, beet leaf hoppers, cotton boll weevils and others Added information might make possible forecasts of great value and increasing long-range accuracy "

As an example of the value of learning of outbreaks early, Dr Annand states that the loss of 3 to 3½ billion board feet of spruce lumber in Colorado from a bark bettle could have been prevented if known control measures had been applied in time Control, he says, is usually economically feasible only on small areas and the attack must be made early before infestation has spread to areas too large to be handled. "The annual loss from forest insects exceeds that from fire, and in many areas exceeds annually the volume cut for lumber " Obviously the reward for successful control is tremendous and well able to pay the cost of a surveying and reporting service

URGENT CRY — Summing up the situation, A I F News, official organ of the Agricultural Insecticide and Fungicide Association, says "Now, as never before, the interests of farmers and consumers alike cry urgently for substantial enlargement of scientifically conducted surveys to develop information leading to increased efficiency in production of food, fiber, feed, and fats, through fuller and more effective use of economic poisons and related materials

"This calls not merely for continuance of the insect and other pest surveys that have been valuable contributions of our Federal and State agricultural agencies for many years The needs of today call for much more than mere maintenance or even normal enlargement of existing surveys We should re-examine the purpose of these surveys, relearn the lessons they teach, and give thoughtful consideration to their possibilities for advancing the general economic welfare

"More than anything else, these surveys should be evaluated in terms of their potential value to American agriculture as a whole and not to segments of it On this basis the conclusion is inescapable that survey work should be placed on a vastly broader and more efficient basis

"Initiation of effective control programs on the desired broader basis awaits development of more fundamental information We need to know what insects, weeds, fungi, livestock parasites, and other pests are now causing serious economic losses and are not now being controlled We need more information about the crops that lack adequate protection, the weeds that should be eradicated, the acreages of crops infested, and for a multiplicity of crops we need facts on the extent to which protection may be expected to prove economically feasible "

Clearly this segment of the chemical industry has adopted a constructive attitude toward the problem of tremendously enlarged government controlled and sponsored research By thus outlining, in advance and publicly, the research needs of its field of expertness and special interest, this industry provides at least a partial basis for the development of a program which will supplement and benefit existing activities rather than duplicate and compete with them Other industries could benefit not only themselves, but the people at large, by similarly analyzing the problems of their respective fields to find similarly valuable directions for government research to develop

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COTTON PRODUCTION

More Efficient Because of Machinery-Chemical Teamwork

The foundation for the revolutionary mechanization program now under way in the production of cotton has been laid by chemical developments While mechanical devices have been invented to do many of the tasks involved in growing and harvesting cotton economically, they depend for their effectiveness on the assistance of chemical agents Effective insecticides applied over wide areas mechanically by dusters or airplanes minimize faulty bolls that machines have difficulty in sorting out and at the same time greatly increase the crop yield.

The vexing problem of controlling weeds has been at last solved by an adaptation of chemical-warfare methods. Now a "flame cultivator," so adjusted as to be hamless to the cotton plants, suppresses unwanted growth by flames This machine cuts the cost of weeding cotton from about $5 per acre by hand to a new low of 50 cents per acre

Mechanical pickers of several types are under practical test but all prove efficient only when chemical defoliants have previously caused the leaves to drop off the plants and expose the bolls to the action of the machine Large scale experiments now under way at the Delta Experiment Station, and on large cotton farms, foreshadow a significant revolution in American production of cotton

TEXTILE DRESSINGS

Prevent Shrinkage,
Provide Permanent "Starch"

Two new chemicals, one a permanent "starch" for cotton and rayon, and the other a shrink preventive for wool, promise to improve tomorrow's fabrics

The shrink-proofing agent, called Koloc, is a synthetic resin which reduces shrinkage of wool from the range of 30 percent to as little as 2 or 3 percent It is claimed that it actually increases the strength of the fabric, tests having shown treated samples to be approximately 10 percent stronger than untreated materials Also, up to 50 percent greater abrasion resistance is obtained, promising longer wearing garments

Kandar, the permanent starch, is a thermoplastic resin which is applied to cotton and rayon in the same way that Koloc is applied to wool, with the exception that the cloth is dried at 250 degrees, Fahrenheit, for one half to three minutes In addition to imparting a permanent crispness, Kandar also brightens fabric colors. As a result, dresses, curtains, draperies, and other articles can undergo repeated launderings without becoming noticeably dulled or wilted. The desired draping qualities are permanently maintained. Cotton and rayon, especially, stand to benefit from the new treatment, but it is equally applicable to wool, nylon, and silk

Sweaters, originally same size, were laundered in same manner, untreated one shrunk, Koloc-treated one did not

Both of these products, developed by the United States Rubber Company, are invisible after application and are insoluble in laundering or dry-cleaning solutions

SWEETENING AGENT

New Synthetic Compound Is 4000 Times Sweeter Than Cane Sugar

Reported by Professor Pieter Eduard Verkade of Delft Technical University, Holland, a new chemical compound, 1-*n*-propoxy-2-amino-4-nitrobenzene, is said to be 4000 times as sweet as cane sugar It is already being manufactured in The Netherlands and has been used with success as a sweetening agent there and in other European countries where it has been patented Application has been filed for an American patent

In comparison with saccharine and dulcine, the only synthetic sweetening agents in practical use until recently, the new substance suggests many industrial potentialities For example, saccharine is only 200 to 700 times as sweet as cane sugar, while dulcine is 70 to 250 times as sweet

The new benzene derivative is a powder-like substance produced in the form of orange crystals It is one of the group designated as the 1-alkoxy-2-amino-4-nitrobenzenes The members of this group range in sweetening power from 120 to 2000 times that of ordinary sugar and are characterized by a purely sweet taste with no secondary or after-taste

The *n*-propoxy compound is perfectly stable in boiling water and in not very strongly acid mediums Its solubility in water is 136 milligrams per liter at a temperature of 20 degrees. The sweetening power of the saturated solution is equal to that of approximately 50 percent cane sugar solution Diluted with some suitable substance, such as lactose or milk sugar, this compound provides a product which may be used as a sugar substitute at the dinner table

WOOD YEAST

Is Made From
Salvaged Waste of Paper Mill

For the manufacture of yeast from the waste sulfite liquor of Wisconsin's paper mills, a plant will be constructed shortly by the Lake States Yeast Corporation at a cost of $400,000

The production of yeast from sulfite liquor is new to this country although several similar plants are operating in Germany and one is working in Ontario, Canada

In this process the waste liquor, which contains from 2 to 3 percent wood sugar, is neutralized by lime, clarified and fortified with nutrient salts, and fermented The yeast emulsion is defoamed and separated in centrifuges, and the resulting cream is filtered and dried

Wood yeast contains 16 percent more digestible protein than other concentrates now used for cattle rations

Centrifuges in a German yeast plant

The taste of wood yeast is pleasant enough so that it can also be used to satisfy human nutritional requirements Added to such foods as soups and spaghetti, it can replace a similar amount of more expensive animal protein In addition to protein, yeast is an excellent source of the vitamin B complex and minerals

Not only is a valuable food obtained, but the primary objective—elimination of stream pollution by processing of the objectionable waste—is also realized.

The waste sulfite liquor on the North American continent represents a potential source of about 75,000 tons of yeast annually

PLASTICS • in SHEETS

A New Method of Producing Low-Pressure Thermoplastics Laminates, Plus Relatively Low Overall Costs, May Point the Way to Expanded Uses for these Colorful, Durable, and Easily Formed Materials

By CHARLES A. BRESKIN
Editor *Modern Plastics*

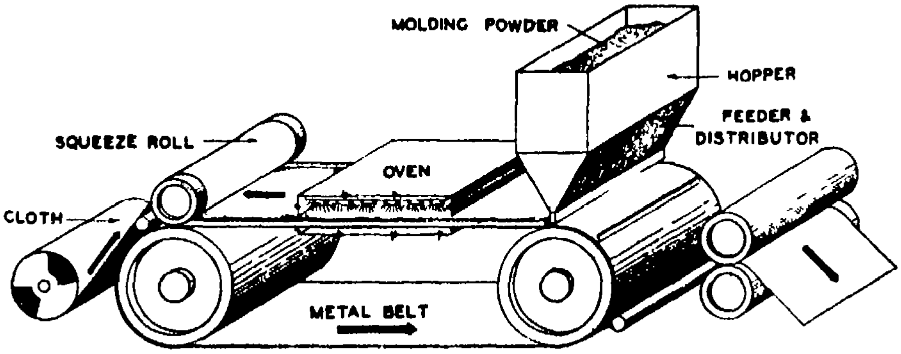
CONSIDERABLE speculation still revolves around the future of low-pressure plastics laminates—compositions of plastics plus paper, cloth, or other continuous supporting media, formed into sheets with a minimum of pressure and heat. Some of the principle end-products to date include suitcases, lamp shades, sales kits, loud-speaker housings, and the like, with others looming in the distance.

Among the issues involved in the current speculation are the relative values of laminates of different compositions, their durability and suitability in certain uses when in competition with non-plastics materials, and the present speed of producing low-pressure laminates, which can be accelerated by processes now being perfected.

There are many authorities in the plastics industry who point to the greater toughness of thermoplastics laminates (in which the plastics used will soften under heat and harden when cooled) as an outstanding advantage in their favor. This toughness, they say, is greater than that of thermosetting laminates (which, when once set, cannot again be softened by heat) and enables processors to make strong and deep draws. Also to be considered on the credit side of thermoplastics laminates—a combination of cellulose derivatives and fabric—is the fact that they offer great color possibilities, since almost any colored or figured fabric can be used as a base and, in some cases, the completed laminate can be covered with a solid color thermoplastic sheet.

• LOOKING AHEAD •

Perfection of a continuous laminating process. Laminating and forming on the same production line. Further lowering of already low costs



Courtesy Hercules Powder Company

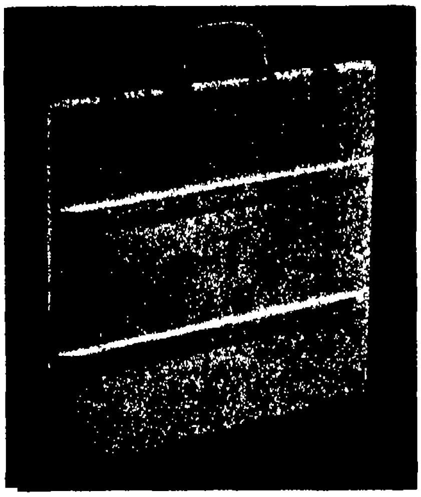
Thermoplastic molding powder, sprinkled from the hopper to the constantly moving stainless steel belt, is melted in the oven, after which it picks up the fabric at the squeeze roller. Cooling on the return trip, the impregnated cloth, easily stripped from the metal band, is ready for laminating in a conventional hydraulic press

Admittedly, there are factors militating against the use of thermoplastics in many applications. Their inability to withstand continued outdoor weathering is a disadvantage. And the wastage of material in trimming the flare from the edges of the mold is considerable, even though the loss can be somewhat offset by using the scrap as filler material for laminates of different construction.

COMPARE ALL COSTS—Whenever the relative costs of materials are compared, misconceptions are apt to develop if nothing more than the price of the raw material is considered. Some manufacturers and designers at times resist the adoption of plastics on the basis that it is more expensive per pound than sheet steel. Yet, if steel is to be colored, for example, it must be cleaned, surfaced, and primed before the finish coats can be applied. This adds to overall cost. If the surface of a finished metal part is scratched, it must be returned to the finishing shop for touch-up. More cost. On the other hand, a piece of plastics colored in manufacture, can have such damage quickly and cheaply repaired on a buffing wheel.

Attractively designed, this sturdy vacuum bottle carrier, made of low-pressure laminate, is easily washed

Cellulose-derivative laminates also have the advantage of easy, rapid fabrication, they lend themselves to straight-line production processes. Plastics from laminating equipment can be fed directly to drawing equipment, thus making



An architect's kit containing model kitchen layouts to aid in home planning is housed in a rigid, waterproof case of thermoplastic laminate

possible fast, low-cost production processes One manufacturer has reported cycles as fast as ten seconds for the laminating of flat sheets Since only 100 pounds per square inch is required to laminate the plastics and only 10 pounds per square inch to draw it, expensive equipment is not necessary When this rapid cycle is added to the low equipment investment, it is clear that the investment cost per pound of finished material is relatively small

PRODUCTION METHODS — Both the Textileather Corporation and the Hercules Powder Company have worked out somewhat differing methods for the coating of fabric with thermoplastics molding powder, which promise to be applicable to mass-production operations

The equipment of the Hercules Powder Company, now in operation, is used in a process of hot-melt coating without a solvent It consists principally of an oven through which an endless stainless-steel belt moves Very fine ethyl cellulose or cellulose acetate molding powder is distributed evenly over the belt by a vibrating feeder, and is carried through the oven where its temperature is raised to 450 degrees, Fahrenheit. Instead of passing through the oven, the fabric is brought down through squeeze rollers into contact with the molten thermoplastics on the belt The textile is picked up by the hot plastics adhering to the metal band, producing a three-layer structure consisting of fabric, plastics, and steel belt This loaded metal belt continues over a roller and back under the machine to the other end of the unit During this time the steel band cools so that the coated cloth can be stripped from it quite easily and either wound up or cut to sheets of the desired length

At present the coater is capable of turning out three feet of coated fabric a minute It is expected, however, that at a later date speeds up to ten feet of coated cloth per minute will be feasible, depending on the kind of molding powder used and the end products for which the job is intended

This method of coating differs from that of the Textileather Corporation which is a modified dry resin process The final results, however, are the same

Coated by either method, the fabric is ready for the laminating press as it comes from the machine Only 100 pounds per square inch is required in this work, and the same type hydraulic press used in any laminating plant can be employed Since the products are thermoplastic, the laminating cycle is simply a heating and cooling operation rather than a curing operation It is this which makes it appear that a continuous laminating process is possible

After a sheet has been laminated —the thickness being governed by the number of plies—it can be drawn into a large variety of shapes Again the sheet is heated, this time to a temperature of 325 degrees, Fahrenheit, and then formed This heating before forming represents the third time the thermoplastics has been heated in the processing of the material The first heating was for the coating operation and the second heating for laminating Thus, it is evident that a continuous process from the raw material through to the formed article would conserve heat On the basis of work that has been done thus far, it is believed that such a continuous operation may be feasible at a future date

* * *

Plastics Compounded—While You Wait

Using a Recently Developed Process, a Fabricator can Prepare His Own Molding Materials in a Single Operation, Without the Aid of a Chemist

THE RESULT of more than four years' research and development, a new process for compounding molding powders requires only one compact machine, from which the plastics emerges ready for molding Markedly different from other methods, this process permits wide flexibility of formulation and color with a comparatively small raw-material inventory, companies that formerly had to purchase all of their molding powders can now compound the materials themselves at considerable savings in cost

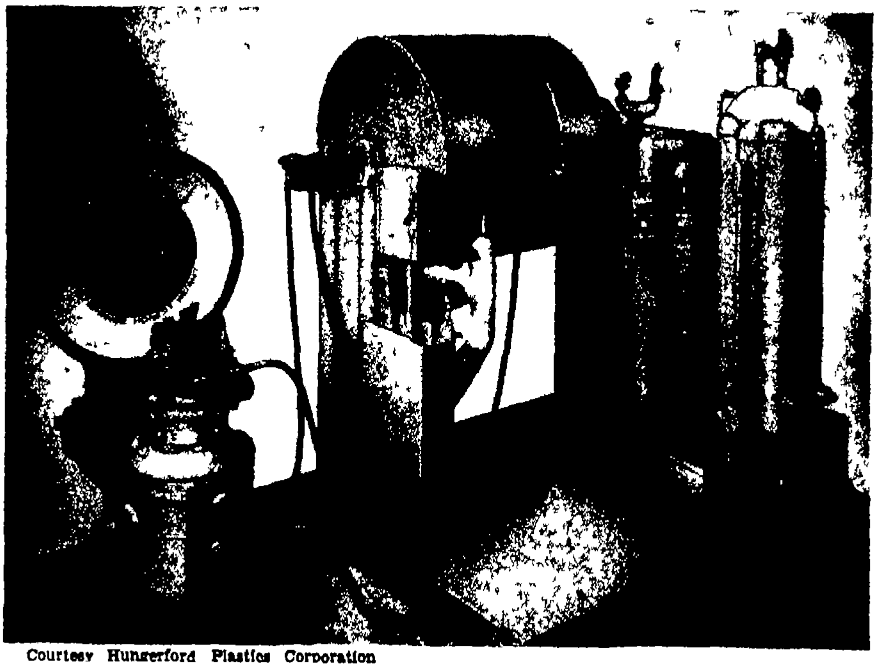
The plastics flake or resin, the pigment, stabilizers, fillers, and so on, are charged into a compounding chamber mounted so it can be rotated While this chamber is rotating the plasticizers and other liquid additives are injected into the chamber by means of a spray After this processing is complete the mass of resulting material is dehydrated It is then discharged into a drum ready for molding

According to the Hungerford Plastics Corporation, who developed the process, it is not even necessary for the companies using this system to have a chemist And as for space, the Plastimaker, as the machine for this compounding is called, and the stock of molding granules is said to take less floor room than is usually needed for inventory stocks of molding powders

The compounding machine is now being produced in 40- (laboratory) 150-, 300-, 600-, and 1000-pound sizes, and licensing of the process has been started It is suggested that before a molder considers putting in the equipment and undertaking to do his own compounding he should be using at least 200,000 pounds of material per year or about 4000 pounds a week

There is not, however, much limitation on the types of plastics material he should be using to adopt this method Thus far the process has proved successful for compounding cellulose acetate, ethyl cellulose and other cellulosic materials, polyvinyl acetate chloride, polyvinyl chloride polyvinyl acetal, and polyvinyl butyral In fact, so far as the Hungerford people know, any plastics material requiring the addition of an external plasticizer can be compounded in this way

HOW IT WORKS—Probably the best way of understanding the operation of the Plastimaker is to fol-


Courtesy Hungerford Plastics Corporation

achine has a capacity of 40 pounds

Courtesy Hungerford Plastics Corporation

The batch of compound being poured from the mixer is ready to be molded

low through the preparation of a batch of material—say 1500 pounds of cellulose acetate First, 1000 pounds of cellulose acetate flake and the colorants are charged into the compounding chamber while approximately 500 pounds of the plasticizer are run into the jacketed liquid reservoir The compounding chamber is then revolved for approximately five minutes at low speed It is at this point that the atomized plasticizer injection cycle is started This takes approximately 40 minutes, and the compounding chamber continues to revolve at the same rate of speed throughout the plasticizer cycle

After the completion of this phase, the dehydration cycle is started Dehydration is accomplished by filtering a volume of dry, hot air through the material This air is automatically and continuously exhausted to the atmosphere throughout the cycle which takes about 30 minutes The compounded material is ready for molding at the end of this operation Power consumed in the hour and a half required to compound a 1500-pound batch of material is approximately 50 kilowatt-hours, or only about 033 kilowatt-hours per pound

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PLASTICS DECORATING

Accomplished by Sand Blast And "Wiped-In" Colors

A NEW approach to the decoration of transparent plastics has been developed in which the pattern is applied only to the underside of articles A stencil of the portions of the design to be deeply colored is laid over the finished article and the acrylic thus exposed is sand-blasted After a few minutes the pattern is switched, the second pattern exposing all of the design whether it is to be lightly or heavily colored

When all areas are blasted to a suitable depth the desired colors are wiped in There is no danger of the pattern being ragged from smeared paints since the color sticks only to the blasted areas The method was worked out by the Venus Glass Company, Inc

One method of decorating transparent plastics objects is exemplified by this fruit dish The design to be colored is sand-blasted, through a stencil, into either surface of the plastics The depth to which the sand is permitted to etch determines the color strength, since it is the measure of thickness of the applied paint film

PLASTICS-COATED MESH

Proves Versatile In Home and Industry

A CELLULOSE acetate coated mesh —either wire or plastics—is constantly finding new applications in agriculture, industry, business, and home No new-comers, the plastics-coated materials date back to the early days of aviation when cellulose nitrate dopes were applied to paper as a cover for glider wings But their applications in some of these newer fields is a departure

The cellulose dopes have, from the point of view of the farmer the particular advantage of invisible ray transmission When applied as a glazing material on the farm, they give the live stock the benefit of covered exposure to ultra-violet rays, a feature which regular glass does not possess

The plastics mesh, known as Vimlite, was an outgrowth of the war when it was employed as a glazing for Army barracks, hospitals, and similar installations It has now been transplanted directly into business and industry For example, it can be tacked on a very light wooden frame and used to separate adjacent machines and processes where the possibility of contamination from flying particles would mean spoilage losses Here the use of glass is very often ruled out by the danger of cracking as a result of the vibration of the machines The cellulose acetate coated plastics mesh, however is light, tough, and nonflammable—all important characteristics of a partitioning material

Vimlite a product of the Celanese Plastics Corporation, can be used in a similar manner in stock rooms and can be employed in place of glass in factory and office windows

With lighter weaves of plastics mesh, Vimlite is being used in table mats, lamp shades, luggage coverings, and even wall coverings, its high abrasive-resistant qualities making it particularly well suited to the last two applications The material is also available in the form of roller shades, being coated with either clear or colored acetate

Salt Baths

• LOOKING AHEAD •

Wastage of metals in processing considerably reduced by elimination of scaling . . . Harder but less brittle steel produced at a lower cost . . . Perfection of uniform case-hardening . . . Soldering in molten salt . . . Thicker metal sections quenched

By EDWIN LAIRD CADY

RED HOT knife blades were plunged into cool water. They came out crooked, wavy, and brittle. Others were plunged into oil. They were less crooked and wavy, but were as brittle as any whittler is accustomed to find them.

A third batch was plunged into a bath of molten salt which had a temperature of 400 degrees, Fahrenheit. They were left in the bath for about three minutes, then were taken out and allowed to cool in the air. These blades were straight, and they were hard—as knife blades must be. When given a severe bending test, they showed no brittleness.

The waviness could be taken out of the water- and oil-quenched blades by further processing, of course. But taking out the brittleness without reducing the hardness would be very difficult. And the blades had to be quenched or they would not be hard enough.

Here, then, was a way to produce better knife blades just by temporarily interrupting their descent from the hardening temperature of about 1450 degrees, Fahrenheit, to the room temperature at which they would be sharpened and used. The process, called "Martempering," is used for hardening thousands of different steel products, it is just one of the reasons why molten salt baths are moving out of the tiny corners of heat treating rooms, taking over large areas.

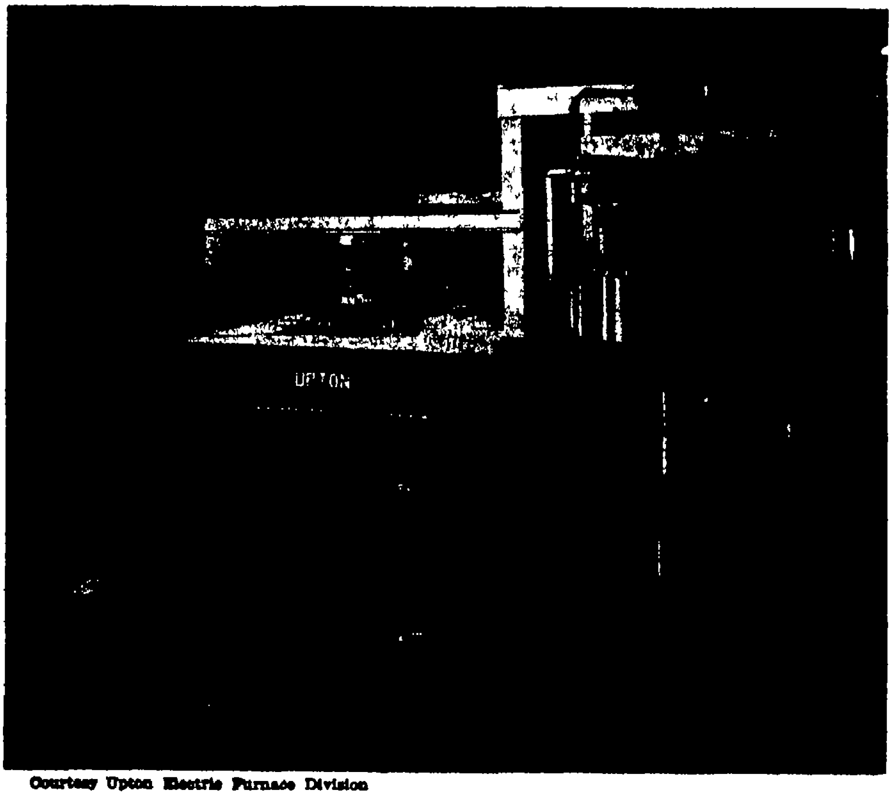
The hard but non-brittle blades also had been heated in a salt bath. Molten salt would keep all air away from them, prevent oxidizing and scaling. More than that, a cold blade when placed in this bath would form a coating of frozen salt about itself, and the coating would melt slowly enough to prevent heat shock to the metal. Once this melting was complete, the molten salt would get at every bit of the surface, heating it evenly, and preventing heat strains. The speed of heating would be high—higher than any other commercial method with the possible exception of induction heating. The higher this speed the faster the production line could move.

Martempering is only one of the interrupted quenching processes for steel. And these processes, nearly all of which are quite new, are causing tons of chemical salts to be used where not even pounds were used before the war. Indeed, many of the interrupted quenches are just receiving their first commercial-scale try-outs.

HOW STEEL CHANGES—Let a metallurgist talk and he would say that those knife steels had been converted from austenite, which is an interior grain structure that steels have at hardening temperatures, to martensite which is an extremely hard structure existing at room temperature. For many purposes the steel would be reheated in salt or oil baths to temper it. This would change the grain structure to pearlite, so called because under the microscope the grains look somewhat like pearls.

Sometimes pearlite is wanted without first going to the martensite stage. Then the steel is quenched in a salt bath at about 550 degrees Fahrenheit, and is allowed to stay there for at least an hour while the austenite changes directly to pearlite. This process, known as austempering, produces a hard steel which is quite free from brittleness, cracks, and internal strains. Austempered steels are far tougher than their counterparts which are quenched and tempered to the same hardnesses in the ordinary way and they make superlative dies or other items which must be hard but withstand shocks.

Up to a few months ago it was thought that neither martempering nor austempering could be performed on metal parts having sections greater than two inches thick. The reasoning was that such parts would conduct the heat from their own interiors to their surfaces so slowly that the salt baths could not hold them at the required even temperatures.



Courtesy Upton Electric Furnace Division

Many baths are fully mechanized

For Metals

While Industrial Potentialities Are Still Being Constantly Probed, the Salt Bath in Several Forms Has Already Provided the Means for Achieving Many Otherwise Impossible Results in Metal Processing

Courtesy Vulcan Corporation

Work, carried on trays through the hardening furnace (extreme left), is spilled into the tank of salt solution for quenching, after which it is automatically conveyed to trays on the loading platform shown at the extreme right of the draw furnace

This reasoning undoubtedly is accurate Nevertheless, interrupted quenching is being used for sections thicker than six inches and with great success The grain structures obtained in the steels are neither true martempering nor austempering, but are mixtures of the two, and of other structures—mixtures so complex and involved that no metallurgist seems to have tried to name them All that is known about them is that such tremendously stressed parts as huge jaws for rock crushers, when heat-treated by interrupted quench methods, are showing at least double the service lives of similar parts made of the same steels but heat-treated by traditional methods

Steel alloys vary in the changes which take place in their grain structures when being cooled from high temperatures Interrupted quenchings can be carried on at any desired temperatures, and can hold their temperatures at any desired points while the structures complete their changes. Hundreds of salt-bath delayed quenches for alloys are under experiment, and dozens of these will probably prove useful

ROLLING MILL TROUBLES—The use of salt baths for the heating of steels is much older than the delayed quench process, but it also is achieving some of its most important advances right this minute In one of the largest alloy steel mills, salt baths were tried for heating billets in order to roll them, the rolling mill superintendent soon found himself in a brand new kind of trouble The scale which former heating methods had produced on the steel had helped the rolls to take hold of the billets This scale was high in friction and once the rolls bit into it, they could start the steel going through them and keep it moving

Preventing the formation of that scale was one of the primary reasons for trying the salt baths. The scale often amounted to 10 percent or more of the steel, which sells for as much as $3 00 a pound. But not only did the salt-protected steel have a lower friction surface for the rolls to grab, even worse, the salt coating which adhered to the steel was slightly lubricating

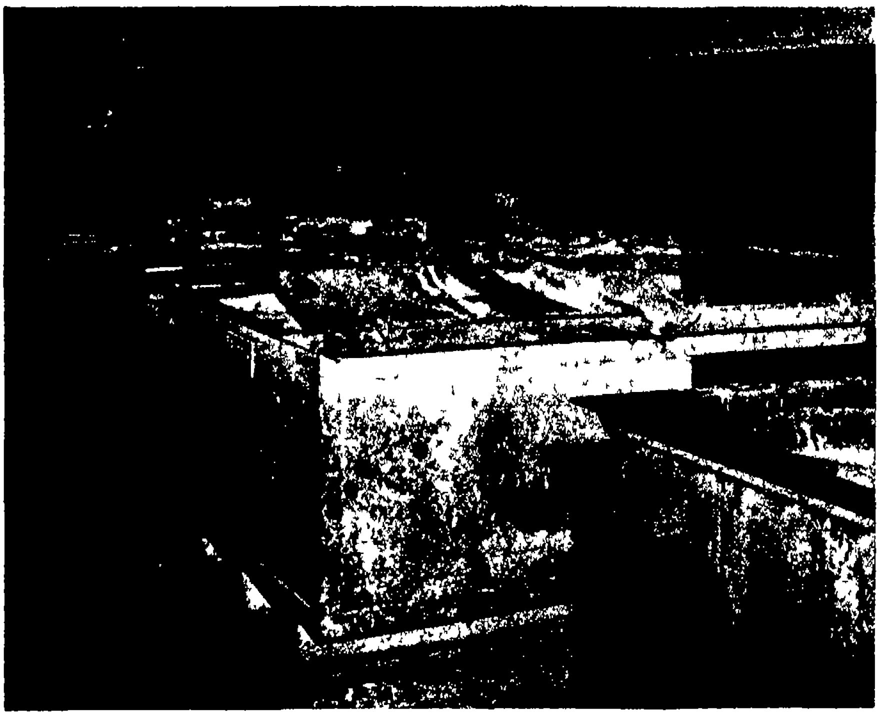
Man-power troubles entered the picture, as they so often do when anything new is tried. One shift was able to roll 100 salt-bath heated billets, the next shift could roll only four The superintendent believes that he will have to use rolls of a diameter at least fifty percent larger, so as to get greater friction contact with the steel, then train a whole crew of men who never have used the old heating methods, and after that he will be able to roll salt-bath heated steel and get a much better product at less cost.

Problems like this one are being solved rapidly, and salt baths are taking over one task after another in the steel mills Soon to be installed are baths which will anneal thousands of tons of steel, eliminate the waste of hundreds of tons of scale, and permit the steel mill metallurgist to segregate heats for special annealing treatment instead of annealing large tonnages in huge furnace loads and being content with average results as he usually does with present methods The result will be better steels, with lower net costs highly probable

BRAZING BATHS — Brazing also is being done in salt baths The parts to be joined are fastened together, with wires or clamps if necessary, but with force fits if possible The braze metal thus is held between them This assembly is immersed in the molten salt bath, and the salt, as usual, reaches and heats every surface Molten salt will pass through tiny apertures, for example through the pores of porous castings, and it gets to the surfaces on which the braze metal is to flow But the braze metal pushes it aside and completes the joining, after which the parts are withdrawn from the bath and the film of adhering salt is washed off

Copper brazing was considered easiest for salt baths, silver soldering more difficult, and soft or lead-tin soldering impossible But with more knowledge of salt chemistry and soldering techniques, silver soldering has become as easy as the copper brazing, and the first commercially successful bath for soft soldering will be in operation before this month is over

Molten salts can give off elements and compounds which will enter the surface of the hot steel, some of



Courtesy Morse Chain Division Borg Warner Corporation

A battery of salt bath carburizing furnaces

which could be harmful Nitrogen, for example, could lessen the corrosion resistance of stainless steel Carbon could have the same undesirable result But there are plenty of parts for which it would be valuable to add nitrogen compounds and nitride their surfaces, add carbon compounds and carburize their surfaces, or even do both And other salts which have only neutral effects can be found for the stainless steels

THIN, HARD CASE—The use of cyanide for hardening is old It gives an extremely thin case, seldom deeper than 0 010 inches, and usually shallower than that But that cyanide case adds the hardness of nitriding to that of carburizing It is extremely hard—much harder than that usually obtained by deeper carburizing alone

And that thin but extremely hard case is best for some products An automobile timing chain, such as the ones made by the Morse Chain Company Division of Borg Warner Corporation, is an example Such a chain when measured over two 20-tooth sprockets, one of which can be moved for measuring the chain length, can have no length variation which will cause the center-to-center distance of the sprockets to vary more than plus or minus 005 inch This means an average tolerance per joint or pitch of the chain of only 00035 inch Wearing a chain part down as much as 001 inch would throw this tolerance way off The best way to harden such parts is to have the hardest case obtainable so as to prevent even the slightest wear, and not to bother about having that case very deep

Originally, cyanide hardening was done with either potassium or sodium cyanide, but the strengths of the mixtures and therefore the depths of the cases were hard to control By making mixtures of 25 percent cyanides and 75 percent other salts the baths became so easy to control that cyaniding now is done on a continuous flow basis, the parts being automatically carried into and out of the baths and to the quenching and washing tanks

Salt baths were found which would nitride steels, especially the aluminum alloy steels, without carburizing them at all The nitriding can be done at lower temperatures 960 degrees, Fahrenheit, being enough—as contrasted to at least 1600 degrees for carburizing This solves temperature strain problems for some parts

Other processes have gas bubbled up through the salt baths Chapmanizing, for example, bubbles dissociated ammonia through the cyanide salt bath, adding more nitrogen to the case than will cyaniding alone

One of the late comers is the salt-bath descaling of metals The metals are plunged cold into sodium hydride mixtures and then quenched in water The sodium hydride at 700 degrees, Fahrenheit, takes the oxides out and so loosens the scale, then the water forms steam beneath the scale and blasts it off Other processes use special mixtures of caustics and of salts into which forgings, at forging temperatures, are plunged to simultaneously quench and descale them And although these descaling methods are in their infancies, many new developments of them are to be expected

No one knows how old the salt bath for metals treating is, nor how new it is going to be It undoubtedly was used by the ancient Egyptians But it is as new as the age of chemistry

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PLUG WELDING

Found Profitable When Casting Defects Are Planned

Up to comparatively recent days, the plug welding of a casting to fill its cavities and make it useable was considered a confession that something had gone wrong in the foundry Intense studies were made to improve casting designs and foundry practices to eliminate the defects And these studies still are a good idea

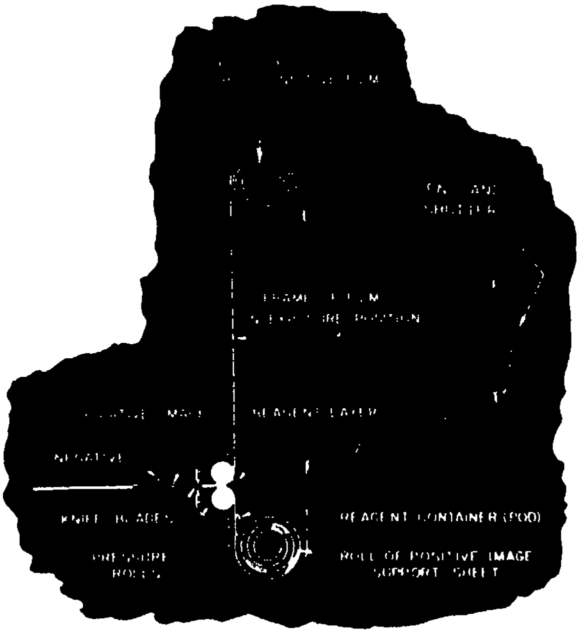
With the improvement of welding rods and procedures, however, an opposite course often has proved profitable Castings are planned to save foundry costs by having predicted types and locations of defects The defects first are studied with production X-ray equipment, and then the welding corrects them Gains are in savings of overall costs, and in the fact that the X-ray searching for hidden defects is a valuable safeguard which now can be paid for by charging it to the overall savings

FAST-ACTING FURNACES

Essential to High Production With Shortening Work Week

Depreciation and obsolescence of factory equipment go on day and night, whether the equipment is at work or not If those factors are to be paid for and profits made in the modern short work weeks then more must be done by the same equipment within the fewer production hours This means that power and steam response must be instantaneous when called for Neither men nor machines can wait while a slowly acting boiler gets up more steam

Pulverized coal plants, Diesel plants, gas fired equipment, and central station electrical power all are quick in responsiveness, and are replacing slowly-acting coal furnaces as rapidly as they can be obtained And the shorter the work (or production) week becomes, the greater will be the necessity for these installations.



Simplified sectional drawing of a camera using the new Land process

PICTURES • in 60 Seconds

By Violating One of the Basic Rules of Photo-Finishing, a Method has been Perfected for Exposing a Photographic Film and Obtaining a Finished, Dry Print Within One Minute. No Darkroom is Needed. Printing Operation, Performed Without Light, is Entirely Chemical

By HARLAND MANCHESTER

• LOOKING AHEAD •

A whole new photographic industry based on the first big advance in the art since the dry plate. Millions of existing cameras outmoded. Sharp increase in "snapshooting" as a result of new convenience and simplicity. Application of revolutionary principle to movies, industrial photography, X-ray work

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A FEW summers ago a young scientist of Cambridge, Massachusetts, managed to snatch a brief vacation trip with his family. He took along his camera and several rolls of film. As he snapped his two small daughters at play, he wondered, as we all do, how his pictures were going to turn out.

One day he remarked that it would be a fine idea if someone would invent a camera that would do the whole job at once and produce a dry, finished print every time you snapped the shutter. Others may have speculated in like vein, but this man was Edwin H. Land, one of the country's most brilliant innovators in the optical field. Having posed the problem, he proceeded to think out a completely new photographic process which would eliminate the darkroom, the developing and fixing baths, the printing paraphenalia, the washing, the drying, and so on, and telescope the whole fussy, time-consuming business into one simple, sure operation performed quickly in the camera itself.

When Land returned to work at the Polaroid Corporation, of which he is founder and president, he had the answer in his head. But his firm was heavily occupied with other matters, and for many months the new method remained a personal project for which he could devote only a part of his time in his private laboratory at the plant. Despite this handicap, he proved in a remarkably short time that his theory was correct.

THEORY TO PRACTICE—Soon he was taking pictures, first in his laboratory, and later on Cambridge streets, with a camera which he had improvised from a folding Kodak. If you examined it closely you could see that it had a roomier back and a small crank on the side. After he snapped an old doorway or a child at play, he gave the crank a few twists. You would have said that he was winding the film. Actually he was developing the negative and making the print simultaneously, and in 60 seconds he could have shown the finished picture. The roomy back concealed the secret until he returned to his laboratory. There he opened it and found good, clear prints, indistinguishable from snapshots developed and printed in the ordinary way. His basic idea proved to be absolutely sound, but there were still plenty of details to be cleared up.

As soon as war orders eased off, Land opened a special department and assigned a staff of technicians to help him in the secret project which was given the code name of "SX70." Innumerable experiments were made before he felt ready to announce the discovery. Now this new process, announced only a few weeks ago at a meeting of the Optical Society of America, is appraised by experts as one of the greatest advances in the history of photography. Production plans are yet to be completed, but in due time the new idea should be available to everyone who snaps a shutter. The process is mechanically simple, and can be applied in producing cameras of all sizes and prices. Its appeal to the amateur is immediately apparent, and in many industrial, scientific, and military uses it can save time and money.

THE MECHANISM—I have seen scores of pictures taken by the new process, and find them perfectly satisfactory. The mechanism of the Land roll-film camera which I saw is similar in many respects to that of the ordinary camera. There are the usual lens, bellows, and cylindrical film cartridge for the unexposed negative Loading it, however, is a double operation, for at the lower end of the camera, where the exposed film is usually wound, you insert a roll of printing paper Above this paper cartridge is a pair of steel rollers located in the rear wall of the camera, and you thread the ends of both film and paper through these rollers After you snap your picture, exposing a section of film in the ordinary way, you turn an outside knob which rotates the rollers and pulls the necessary length of film and paper through a slot to the outside of the camera Glued across the paper, at intervals representing the length of one print, are a series of narrow, metal-foil envelopes, or "pods," each containing a carefully measured quantity of a thick, sticky paste As you turn the knob, the little "clothes wringer" squeezes open one of the pods, and the paste is spread evenly between the negative and the paper, forming a tightly compressed sandwich When the sandwich has emerged from the camera, you cut it off by means of opposing knife blades mounted in the slot

The sandwich now in your hand is a miniature darkroom, for both sides are protected by light-proof layers You wait for about one minute, and during this time the paste, chemically known as a reagent, simultaneously develops the negative and makes the print No exposure to light is required for printing Then you peel them apart and there is your finished picture, neatly framed in a white border It does no harm to leave them attached longer, for the chemical process goes to completion and then stops

This much, which you can see, appears simple enough Standard films may be used, and up to the point where the sandwich is made, there is no deviation from ordinary camera procedure Even the operation which takes place after the sandwich is formed may use standard chemical tools, but in other respects it departs radically from all previous photographic processes

To review what happens in ordinary photography the film is composed of a base on which is coated an emulsion of light-sensitive silver bromide crystals suspended in gelatin Each crystal, according to the accepted theory, is equipped with a "trigger"—a tiny speck of silver sulfide—which is "set" for development when light falls upon it in taking the picture When the film is exposed to the lights and darks of the scene photographed, the triggers are set in the white areas but not in the black. So in the developer, the crystals in the prepared areas are chemically converted into metallic silver, forming the black of the negative. The solvent bath gets rid of the unexposed crystals by dissolving them to leave areas of transparency The result is the familiar black-and-white negative In making a print, the paper is exposed to light passed through this negative, then the two bathing operations are repeated to develop the blacks and clear the white areas in the final picture Washing and drying conclude the job After you snap the shutter, eleven separate and distinct operations must be performed before you can see the finished dry print.

RULES VIOLATED—Land combines all these operations by violating a basic rule dinned into all amateurs *Don't let your hypo get mixed with your developer!* He puts them together in his reagent and gets away with it This reagent may contain commonly used photographic chemicals In one of his successful recipes, the developer is hydroquinone in the presence of sodium hydroxide, sodium thiosulfate is the solvent, and sodium sulfite is used as an antioxidant and for other purposes These chemicals are mixed with a soft plastics which distributes them evenly, gives the mixture just the right stickiness, and acts as a spacer to keep the two sides of the sandwich a few ten-thousandths of an inch apart

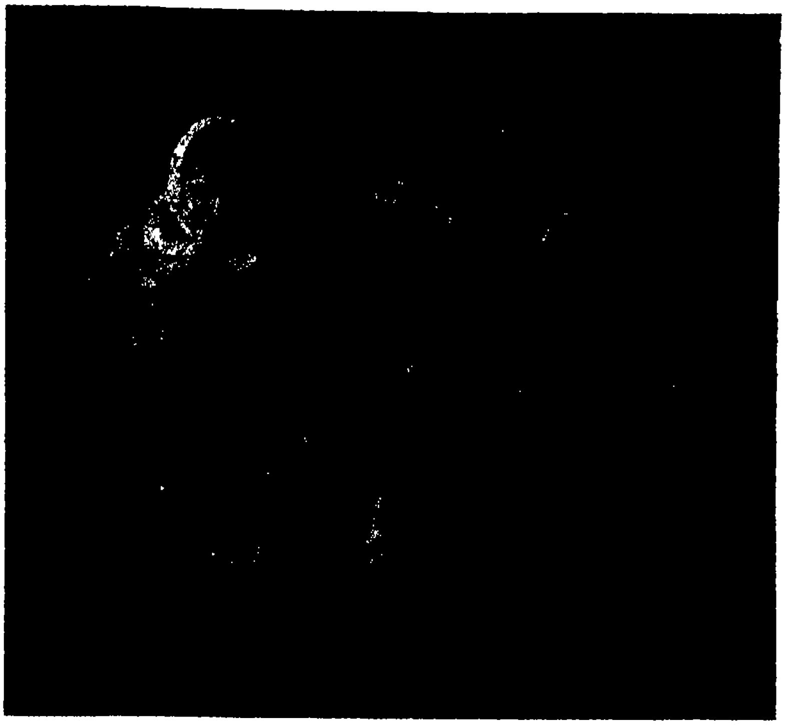
Inside the sandwich, the developer first goes to work on the negative, converting the light-triggered crystals of silver bromide into black, metallic silver After a slight time-lag, the solvent goes to work on the areas where no light has fallen, converting the untriggered silver bromide into silver ions and free bromine In standard developing, these silver ions are thrown away in the washing, but in Mr Land's sandwich, most of them migrate to the positive side through a chemical one-way gate and are built up into black silver deposits on the surface of the print So while the unexposed areas of the negative become transparent, the opposite areas in the printing paper become black, as they were in the object photographed The reagent paste is nearly all used up in the process, the residue is automatically disposed of, and you have a dry, finished print

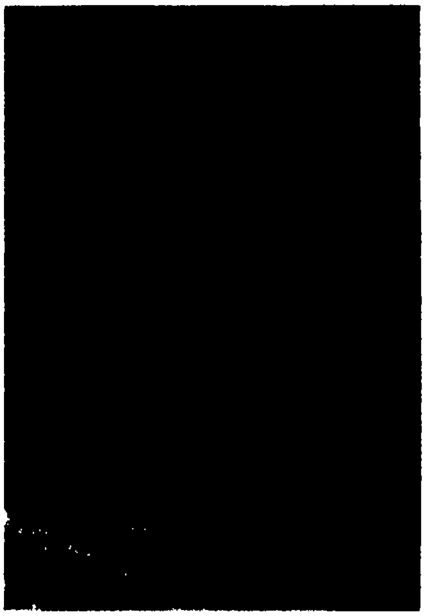
Land has tried other methods of making the sandwich, among them packaging the paste in tiny, breakable cells imbedded in the surface of film or paper, and attaching it as a coating to the printing paper, which is then rolled up to protect it until it is used One of these variations may turn out to be suitable for specialized photographic uses

Few modern inventions are so completely new Back in 1889, W D Richmond devised a method for developing and fixing a negative in the same bath, but it took twenty minutes and was no real improvement In 1927 a group headed by Henry Morgenthau, Sr, paid Anatol Josepho $1,000,000 for his patents on the Photomaton, the bulky machine seen in amusement places which develops and prints a portrait in a few minutes by automatically copying the wet darkroom process Two years ago, Vannevar Bush speculated in a magazine article on the advantages of snapping a camera and seeing the dry picture at once, but offered no ideas for inventing such a process Then in a Warner Brothers' film, "The Horn Blows At Midnight," a celestial photographer snapped Jack Benny and pulled the finished print from his camera Only these remote relatives of the Land process can be found in fact or fiction

INVENTOR LAND—No one who is familiar with this 38-year-old scientist's career is surprised that he should make such a revolutionary invention When he was a boy of 15 working in his home laboratory in Norwich, Connecticut, he got his teeth into an apparently insoluble scientific problem which had baffled able physicists for a century—how to make light-polarizing crystals in sheet form Eight years later he announced the answer before a meeting of Harvard scientists Others had tried to "grow" large single crystals to regiment light—his solution was to imbed vast numbers of tiny crystals parallel to one another in a cellophane-like sheet, so that they would govern light like one huge crystal Light waves, which normally vibrate helter-skelter like a Fourth of July sparkler, are combed out as they pass through the sheet's invisible "slots," and proceed in orderly parallel rows

Leaving Harvard, Land set up a plant to manufacture the sheets, and nearly all the light-polarizing articles now popular in many fields stem from his discovery Among these are sun glasses, camera filters to cut the sun's glare, the circular light-controlling windows used on crack trains and airplanes, startling three-dimensional motion pictures which have been seen by many audiences, the three-dimensional vectograph films used by aerial reconnaissance men during the war to gage surface contours, and, perhaps most important of all, polarizing lenses and windshields, which,





if they are adopted, will eliminate dangerous headlight glare in night driving

Now it looks as though Land's photographic invention will eclipse all his other accomplishments in the public mind He is confident that all the "ifs" have been dealt with by the innumerable experiments and tests which have been going on in his laboratory for many months

PROOF TESTED—Since he built his first camera, he and his helpers have made approximately 20,000 photographs by the new process These include indoor and outdoor shots, portraits and landscapes made under all imaginable conditions He has subjected thousands of photographs to gruelling accelerated tests in equipment designed for the purpose In a rotating device resembling an enclosed ferris wheel the prints are exposed to intense simulated sunlight in attempts to fade them In artificial weather rooms they are tested in frigid and torrid temperatures and high humidity

All tests support Land's belief that the pictures are as satisfactory for most purposes as those made by the conventional process, but there are certain differences in behavior Land recommends that his camera be used within the temperature range of 30 to 100 degrees, Fahrenheit, although he has taken good pictures at temperatures as high as 110 and as low as 15 degrees, Fahrenheit These limitations, which may be removed by research now under way, would not seriously hamper most camera-users On cold days, a winter sports photographer could slip the sandwich beneath his coat to keep it warm during the sixty-second period of developing and printing

The process requires more accurate exposure than does the conventional method Correct exposure lies within a range of about two stops—that is, you can give it twice as much light as it should get for best results, or half as much This is about the care you would take in making a Kodachrome picture On the other hand, this process yields higher speed for the grade of film used than does the present process, Land points out. It makes Verichrome film behave like Super-X Actually, you don't need transparent film at all in some forms of the new process The light doesn't have to pass through the negative in printing, so a roll of sensitized paper will do just as well at a fraction of the cost

OVERALL COST—That brings up the important question Can the average amateur afford to use the new process? The answers are reassuring In the camera described, two small steel rollers, a slot, and the built-in knife blades are the only parts added to the standard camera The reagent is not very expensive, but of course it has to be packaged in the little pods and accurately glued to the printing paper Land has designed an automatic machine to do these jobs The paper itself is somewhat less expensive than that commonly used. To sum up, both camera and materials will cost something more than their standard rivals until they get into the mass-production stage After that, Land believes that photography will cost less per finished print than it does now He also points out that he is setting his sights for the millions of amateurs and he wouldn't be thinking that way unless he could put the price within their reach

The great appeal of such a camera to amateurs is apparent Vacationers and groups at reunion can exchange snapshots wherever they are, instead of trying to remember to mail them Names and other data can be written on prints before they are forgotten The process is self-correcting If you make a mistake in taking the first picture, you can take another at once The process can be used with either the roll or the film-pack type of camera For the latter, there can be a storage compartment so that, if you wish, you can let your photographic sandwiches accumulates and peel them at leisure The process can be used, not only with standard lenses, but with any special-purpose lens or filter, for it is identical with standard photography up to the point where the simultaneous developing and printing takes place

Amateurs will probably discard the negative after they have peeled open the sandwich, and will obtain copies either by taking another picture or by having the first print copied In some variations of the Land process, the negative can be used to make additional prints by the ordinary method

WHAT IT CAN DO—Anyone can write his own list of practical jobs for the new process During the war, when portable tent darkrooms were used for rapid processing, Land's method would have been much faster and less cumbersome, especially in reconnaissance planes The infra-red pictures of enemy installations which were taken in the dark could have been developed and printed at once, greatly increasing their value News photographers can return to their offices with finished prints, saving several minutes at edition time Photographic copies of documents can be made at once, eliminating the delay now imposed by photostating In many cases the process may bring about faster police identification of suspects and victims

X-ray prints have been turned out by the Land process in about a tenth of the time needed to develop a film by current methods The prints made so far are not as detailed as the X-ray negatives commonly used, but they may be of great value where speed is essential They can provide a quick look at a fracture, and in factories they may hasten the job of locating flaws in castings

News of the Land process has aroused tremendous interest among experts and amateurs alike It is roughly estimated that more than a billion and a half still pictures are taken every year in the United States If even a fraction of this work is done by the Land camera, the time saved in darkrooms and in trips to the drugstore will be impressive

ONLY IN NEW CAMERAS—While it would be simple to adapt the new process to some expensive cameras by means of a special back, adaptation of all types would be impractical, so we may expect to see the process marketed in a new camera

The Land process is described by Arthur C Hardy, Professor of Optics and Photography at M I T and secretary of the Optical Society of America, as "revolutionary as the transition from wet plates to daylight-loading film." In Prof Hardy's opinion, the prints compare favorably with those made by the standard method He points out that since the Land process automatically reproduces contrasts correctly, it may be too faithful for the "creative" photographer who introduces distortions in the darkroom in order to obtain special effects But this will not concern the average man who wants to take pictures, nor the industrial photographer

Mr Land is now concentrating on the use of his process for black-and-white photography, and we may expect an announcement of manufacturing plans before the end of the year Looking toward the future, he can see no inherent reason why it cannot be adapted to color photography Still farther ahead lies the motion picture field It is no wild speculation to say that movie film can be processed rapidly in much the same way if there is a demand for such speed In television, for instance, it might be useful for taking spot movies of newsworthy events and rapidly putting them on the air There would be a great deal of engineering to do, but it is entirely possible that in a few years we will be taking home movies and showing them on the screen a few minutes later

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Rock Drilling With Flame

High Temperatures, Produced by Burning a Flux-Bearing Fuel in Oxygen, Melt Rock or Cause it To Spall or Flake Process Reduces Mining Costs

INCREASING drilling speed ten times over that of older methods, a new process for making vertical blastholes in hard, low-grade iron ore is known as fusion piercing In this process, developed by The Linde Air Products Company, a flame, produced by burning oxygen and a flux-bearing fuel in a special blowpipe, is directed against the surface of the rock or ore The high flame

Blast-hole blowpipe approaching a full-depth pierce Expelled granulated slag is piled around the hole

Above Blowpipe coming out of hole at end of run Below A six-inch blast hole produced by fusion piercing

temperature—about 4000 degrees, Fahrenheit—causes some kinds of rock to spall or flake off, and the flux in the fuel causes other kinds of rock to melt Pressure of the burning gases forces the molten material past a water spray where it is quenched and broken up In the quenching process water turns to steam and the steam helps the gases force the quenched material out of the hole Equipment for commercial use is still in the development stage For field tests, however, a truck was equipped with a portable oil-field drill rig—a 30-foot special blowpipe replacing the "kelly"—and with pumps, tanks, motors, and special recording instruments A more compact and less complicated commercial machine will result when the apparatus that is on the experimental rig solely for the purpose of collecting data is eliminated

Field tests were made on Minnesota "taconite"—an extremely hard, tough, abrasive, low-grade iron ore Six-inch diameter holes up to 30 feet deep were fusion pierced at an average rate of 10 feet per hour, with rates as high as 17 feet per hour for short periods This compares with an average speed of about one foot per hour for drilling holes of similar diameter in this ore

Speed in making blast holes helps reduce mining costs in large-scale operations In addition, it has been found that the high-temperature piercing flame produces stresses in the surrounding ore which causes better fragmentation during primary blasting, further reducing costs Mining men who saw the tests say that fusion piercing will have many advantages in the mining of low-grade ore

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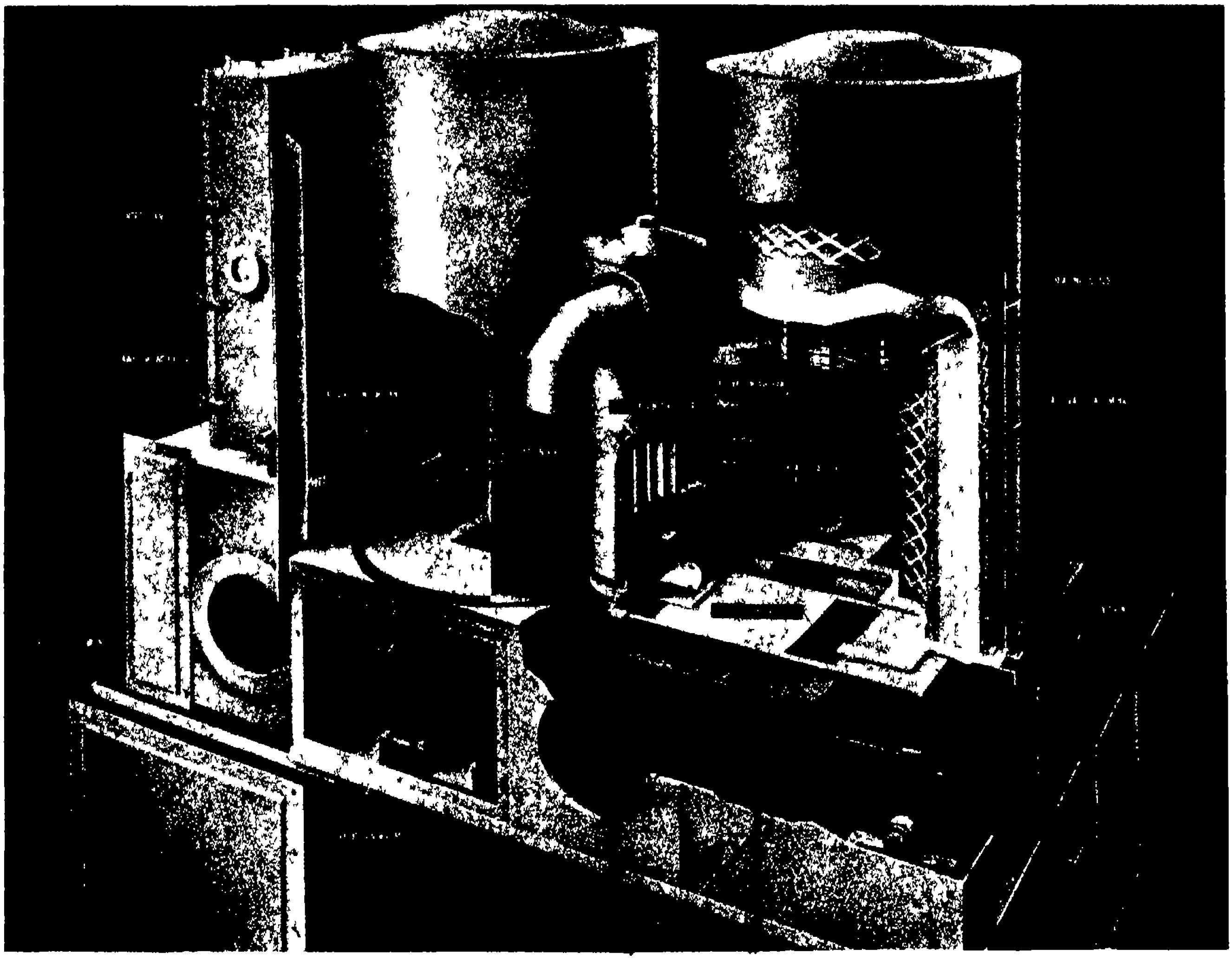
Air Drying For Preservation

Storage of Materials and Equipment, Without Loss Through Corrosion or Other Moisture-Caused Deterioration, Now Possible Through Use of Equipment Originally Designed for Protection of Inactive Naval Vessels

MACHINES which made possible the major portion of the Navy's fleet preservation program, popularly known as "Operation Zipper," are now available to private industrial and commercial users

Although pre-war dehumidification equipment found its widest use in the metallurgical, chemical, and pharmaceutical fields and in the oil and gas industry, its successful use in the fleet preservation program has opened new and potentially greater markets The principal problem solved by the Navy in the preservation of a ship and its machinery and contents is much the same as that which any number of industrial and commercial organizations are facing today in the preservation of materials and equipment



Handling 500 cubic feet of air per minute, the dehumidifier operates on the "solid adsorption" principle held in storage The problem is How to prevent airborne moisture and atmospheric conditions from causing the corrosion of metals and mold, mildew, and general deterioration of materials ranging from bedding to a box of chewing gum

In protecting machinery, equipment, and materials from the corrosive effect of humidity the Navy, long before World War II, found that preservation by means of coatings alone was not effective Therefore they came to the conclusion that the atmosphere within the vessels of its inactive fleet must be maintained at a relative humidity of 30 percent or less, for at this point general deterioration is inhibited for indefinite periods

In the application of dehumidification equipment to private use, the cost of installed equipment and power cost is, perhaps, of first consideration The Navy found that the installed equipment cost is less than one cent per cubic foot of ship's volume in the majority of cases It also found that power cost runs well below 15 cents per 100,000 cubic feet of volume per day with power at one cent per kilowatt-hour Or, to put it another way The dehumidification power cost for a destroyer having a volume of approximately 250,000 cubic feet is about $110 per year on a $7,000,000 investment

These dehumidification machines, manufactured by Lectrodryer Corporation, remove moisture and gases from the air by the physical phenomenon known as solid adsorption Even though solid adsorption is not completely understood, it has been demonstrated that a distinct affinity exists between certain types of surfaces and the molecules of certain gases which causes the gases to attach themselves to the surface of the solid. Actually, in effect, the gas is condensed to a liquid and, in so condensing, latent heat is given off It has been found that temperature is an important factor in affecting the affinity of certain gases for attaching themselves to solid surfaces The application of heat to the solid will cause a release of the adsorbed liquid This application of heat is known as reactivation and is the basic principle through which Lectrodryer equipment operates.

GERMICIDAL LAMPS

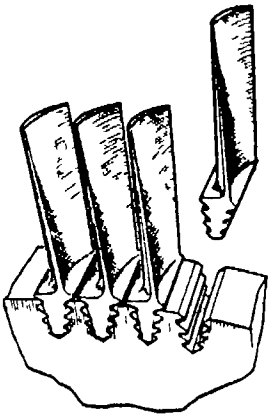
Installed in Schools, Cut Rate of Absences

When bacteria-killing ultra-violet lamps go to school, the absenteeism of the pupils declines, averaging up to 50 percent in test results Summarizing results of a continuing study of ultra-violet's effectiveness, a spokesman for the Westinghouse Electric Corporation stated that sharp decreases were reported during the past three years in the absences of both pupils and teachers in classrooms protected by lamps emitting air-purifying rays, compared with absences in unprotected rooms Although more data are needed, evidence already accumulated points to a good possibility that ultra-violet ray treatment of indoor air can reduce considerably the incidence of "pass on" respiratory diseases

TURBINE BLADES

Require Many Complex Operations in Making

Turbine blades for the British De Havilland Goblin II, turbo-jet engine are in themselves symbolic of the production problems often encountered in present-day manufacturing The turbine part of the Goblin II has 83 rotor blades arranged around the periphery Directly in front of this is a fixed-disk stator having 77 blades The moving turbine wheel, secured by studs to the flange of a substantial center shaft, is approximately 27 inches from tip to tip and comprises a solid disk with the blades held in slots broached to a "fir tree" form The root of each blade must be accurately machined to a similar form, inserted by light blows from a rawhide hammer, and secured by peening-over at each side The rotor blades are of airfoil form and taper slightly in width from tip to root


'Fir tree" roots on turbine blades

To withstand the high temperatures and stresses encountered in service, the blades are made of hard, tough alloys, with a high nickel content The use of this material, however, gives rise to many problems during manufacture, especially as the blades are completely machined on all surfaces The operations include milling, drilling, and broaching to very close limits.

As received at the factory the stampings are of approximate blade form, with a rectangular-section club at each end. One end provides material for the fir tree root, the other is a dummy end to facilitate holding during various machining operations In fabricating the blades there is a long and careful sequence of operations and each stage must be done meticulously Also, each stage demands the best machine-tool equipment plus ingenious fixtures and so on.

Thus, the question arises as to whether, as gas turbines come into more frequent use, such a multiplicity of operations will continue to be necessary It appears likely that forgings or castings much nearer final form will be demanded or else one or two special machines will be built to accomplish what at present appears to be 54 operational sequences.

COLORIMETER

Aids in Standardizing Fluorescent Light Quality

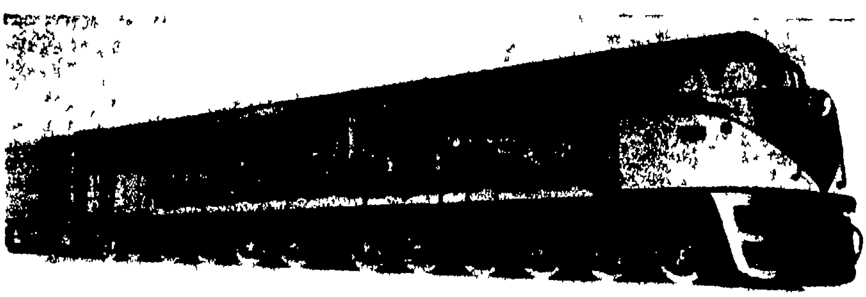
Electronic "eyes," able to describe color far beyond the ability of the naked eye, are now being used to standardize the radiated colors of fluorescent lights and of cathode-ray tubes

Applied to fluorescent lighting, the photoelectric colorimeter insures that all lamps in one color line will be within the limits of one single shade, with no "off shades" occurring in the line Thus, when a number of lamps are in use and a replacement lamp is needed, trial and error in selecting the identical shade is eliminated

Used in television receiver manufacture, the colorimeter, ensures a standardized intensity of "desirable" white light on the television screens of various sets

The colorimeter uses a system of color filters linked to photoelectric cells to read color Each of the filters shows the amount of their color that is emanating from the radiating color being tested For example, if a white fluorescent lamp were being tested, the red filter would tell how much red light the white light source was emitting, the blue filter would tell how much blue light was being emitted, the green filter would tell how much green light was being emitted, and so on

Meantime, the photo cells, which transpose light into current pulse send out different pulses for each of the colors in ratio to the strength or amount of these colors The pulses register on an indicator dial, and the readings then can be checked against a color graph or chart to determine if the light being



One half shorter and one third lighter than conventional Diesel-electrics

tested meets the standard set The colorimeter is used by General Electric Company in manufacturing fluorescent lights and television receiver-screen tubes

DIESEL SMOKE

Controlled by Use of Good Fuels, Prevention of Overloading

SMOKE from Diesel engines, long a cause of public complaint, is an unnecessary evil which can be eliminated by keeping engines in good repair, operating on good fuels, and by preventing overloads, claims Professor P H Schweitzer, of Pennsylvania State College Unfortunately, he adds, smoke is eliminated at the cost of engine efficiency since, with current injection equipment, prevention of overloading throughout the entire speed range involves reduction of low-speed torque, or lugging ability He says, however, that experiments indicate that normal engines burning normal fuels have smoke-free exhausts between one quarter and three quarter loads Light loads may cause cold smoke, overloads increase smoke density Belated injection timing, poor fuel mixing, low fuel volatility, and low cetane number are also said to contribute to smoking tendencies

TRUCK-BORNE LABORATORY

Gives Speedy, Non-Destructive Analysis of Scrap Steel

ON-THE-SPOT steel analysis is now routine at the Rouge plant of the Ford Motor Company, thanks to a mobile laboratory unit designed and developed by the company's chemical and metallurgical research department

The new unit, already paying dividends as a time saver, is used mainly for the rapid semi-quantitative analysis of incoming carloads of steel scrap and kindred operations in which time is of the essence This technique eliminates the necessity of transporting the samples of steel scrap to the chemical laboratory, obtaining drillings, and analyzing them chemically

The laboratory consists of a spectroscope, chemical spot testing and color carbon test equipment, a portable grinder for spark testing, and a gasoline-driven generator as a source of power, all of which is mounted on a panel delivery truck

Still another important function of the mobile unit is its usefulness in the non-destructive identification and sorting of finished production parts of identical appearance but different chemical .analysis

GAS TURBINE LOCOMOTIVE

Seen as Possible Result of New Tests

A MAIN-LINE locomotive of 8000 horsepower, but only half the size of a conventional Diesel-electric design, powered by four 2000 horsepower oil-burning gas turbine engines of a type now undergoing performance tests in the Westinghouse laboratories, has been predicted by an engineer of that company

Designed to burn heavy (bunker C) fuel oil, so that its power output can be economically competitive with conventional rail "prime movers"—Diesels and the familiar coal-burning steam locomotive—the light, compact new gas turbine generator occupies a space only three-and-one-half feet wide, 26 feet long, and six feet high It has the additional advantage of quick starting, a long-suffered handicap of steam locomotives

This gas turbine, which has been under development since the latter part of 1943, and has been running on the test stand since early August of last year, was not designed specifically for locomotive use, but rather is intended to provide basic operating data and to define design problems for a simple, efficient power plant with many possible applications

Although dimensions were intentionally held to those which would be practicable for locomotive drive, such a unit might also be used to advantage in marine, central station, and industrial applications

The power plant now on test is a simple axial-flow unit of the "open cycle" type, in which air from the atmosphere is sucked into one end, compressed and mixed with fuel oil, which is then burned to bring the air temperature to 1350 degrees, Fahrenheit, and finally exhausted back to the atmosphere after the turbine has extracted the useful power from the air's heat

HORIZONTAL FURNACE

Burns Low-Grade Coal With No Slag Troubles

DEVELOPMENT of a new method of burning crushed coal by using a horizontal cyclone burner has as one of its features its ability to burn low-grade coal having low fusion-point ash, with the removal of better than 80 percent of the ash in molten form as slag tapped from the furnace This results not only in relatively clean gases passing over the heat-absorbing surfaces of the unit, but also in much cleaner stack gases than is the case with other methods of coal firing

The performance of this horizontal cyclone burner has definitely proved the principles involved to be sound, providing a simple, reliable, and efficient means of burning coals, particularly of the poorer grades having a high percentage of ash with low burning temperature

Some years ago, the Babcock and Wilcox Company approached the problem of utilizing advantageously the generally considered undesirable characteristics of the ash in coal It was felt that if the ash liberated from the coal upon combustion could be kept in the furnace, it would be possible not only effectively and efficiently to use poorer grades of coal, but at the same time to eliminate largely the slag-cleaning problem so prevalent in both stoker- and pulverized-coal firing And by increasing the rate of burning of the coal, the size of the furnaces necessary for a given capacity could be reduced This would result in a reduction in the cost of making steam, which would be attributable to decreased capital expenditure for the equipment involved, as well as savings in its operation and maintenance

If crushed coal is admitted tangentially to a cylindrical burner in a stream of air at a sufficiently high velocity, the particles of coal will be thrown to the surface of the cylinder and will be carried in the air stream along the wall of the cylinder in the form of an increasing-pitch helix until the energy of the entering stream of air has been dissipated.

If, in addition to the primary air, sufficient secondary air for complete combustion of the coal is admitted in a path parallel to the primary air and coal, and at a correspondingly high velocity, and if at the same time the temperature is sufficiently high to promote and maintain combustion, the volatile matter in the coal will first be distilled and burned, then the remaining carbon will be burned, and finally the ash will be left

Provided the fusing temperature of the ash is lower than the temperature obtained on combustion it will be in a molten state as slag This resulting slag, due to the energy in the stream of products of combustion, will be in contact with the surface of the burner, so that it becomes entirely coated with molten slag

By inclining the axis of the cylindrical burner, the molten slag will drain toward its low point, from which it can be removed continuously As this molten-slag surface of the burner is established, further crushed coal admitted with the primary air, on being thrown to the surface of the burner by the energy of the conveying air, will be caught by the slag

The movement of the slag on the surface of the burner, due to its viscosity, is very much less than the velocity of the entering air, and this provides an intense scrubbing action of the high-velocity air on the combustible particles of the coal entrapped and moving with the slower moving film of molten slag, with resulting extremely high combustion rates

METAL STRENGTH TEST

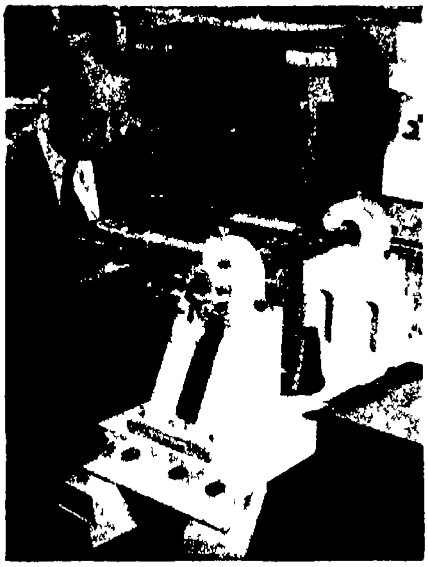
Reveals Durability Under Operating Conditions

Breaking, twisting, and bending hard metals with compressed air is the new method recently developed to determine the strength of metals and alloys

An air-pressure machine, the operating principle of which is similar to that of a slide trombone, is used to vibrate metals and alloys at their natural frequencies until they crack or break under the stress and strain, thus determining their durability for actual operating conditions This is declared to be the most rapid method of fatigue testing known and is expected to bring radical changes in that field

Originally developed to test gas-turbine buckets, the device has proved so efficient and adaptable that, according to F B Quinlan, General Electric engineer who designed the new machine, it will undoubtedly have wide industrial application

The operating mechanism consists of a tuned air column in which the tuning is accomplished by decreasing the length of the air path, much as a trombone player changes the tone of his instrument by moving the slide



Tuned air column can produce stresses up to 100,000 pounds per square inch

Metals or parts of equipment to be tested are attached to a piston, which fits loosely into two cylinders Air pressure is directed through the cylinders so that it vibrates at the same natural frequency as the metal being tested An optical system is used to measure the amount of vibration, while an electric meter at the base of the machine records the resonating frequency of the piece being tested Charts are kept to determine the number of stress reversals the metal can withstand before it fatigued

The machine has produced stresses as high as 100,000 pounds per square inch, with no more air being used than that supplied by the average vacuum cleaner

The fatigue-tester has no moving parts to wear out, as nothing moves but the piece of metal under test

STARCH AND ALCOHOL

From Potatoes Boosted by Use of DDT

Potatoes of finer flavor and more alcohol for industry are promised by using DDT on the potato crop, according to a report by Dr Charles A Brautlecht of the University of Maine to the American Chemical Society's Division of Agriculture and Food Chemistry

A spray or dust of DDT at little cost to growers, will, says Dr Brautlecht, protect the potato plants from diseases and permit Maine farmers to return to growing the once popular and better tasting Green Mountain potato, which lost its popularity in recent years because of its susceptibility to insect-caused diseases

Not only do Green Mountain potatoes taste better, Dr Brautlecht points out, but they have a 2 percent higher starch content than the Katahdin variety, now largely grown in Maine, which leads all other states in potato production

Increased starch content has great significance for modernized starch factories and the potato alcohol industry, the report explains Although production of potato alcohol will not be able to compete with industries producing denatured or power alcohol from low grade corn, waste petroleum, or acetylene, it will have many uses, Dr Brautlecht predicts

Potato alcohol will improve certain alcoholic beverages by blending and will also be utilized in hospitals where high quality alcohol is needed, in druggist's preparations and in French type perfumes, he declares

The manufacture of potato starch in the United States is reviving, and the new potato alcohol industry is getting well under way, as a result of modernized equipment

ACRYLONITRILE

Aids In Making a Wide Variety of Products

A great diversity of articles, ranging from drugs and insecticides to plastics and lubricants, can now be made from acrylonitrile, a component of Buna N synthetic rubber according to Dr H A Bruson of The Resinous Products and Chemical Company

Important during the war in the manufacture of synthetic rubber and of the synthetic drugs which took the place of quinine in the treatment of malaria, acrylonitrile was also the basic raw material for acrylate plastics

Acrylonitrile will react with thousands of compounds containing hydrogen With starch or cellulose it forms transparent films like cellophane and tough synthetic fibers like rayon, and another compound which is especially poisonous to the destructive Mexican bean beetle Other reactions produce drugs, solvents, sizing materials for textiles lubricants, and softening agents for plastics, Dr Bruson declares

RADIATION METER

Portable for Agricultural, Weather, and Other Research

Small and portable, a new, completely self-contained radiation meter provides a direct indication of radiant-energy intensity and is intended primarily for measurement of solar radiation. Thus, the instrument can be used for the investigation of the effect of solar radiation on agriculture, studies concerned with the weather, laboratory tests of the absorption or transmission properties of materials through the visible, and into the infra-red, spectrum, and for general use by government agencies, industrial laboratories, and advanced educational institutions.

The meter consists of two major components — a radiation receiver, which is mounted in a metal enclosure on the top of the case, and a D'arsonval-type indicating instrument which is connected to the receiver output leads.

The radiation receiver is a sensitive thermocouple of the total radiation type. It is sensitive to radiation of wave lengths from 0.3 to 3.5 microns.

The indicating instrument is a permanent-magnet, moving-coil millivoltmeter. The scale length is 1.5 inches and the range of the meter is zero to two gram-calories per square centimeter per minute. Accuracy is within 5 percent of full-scale value. Net weight of the General Electric meter is six ounces. Calibration is accomplished by exposing the instrument under test and a standard precision radiation meter, to a source of radiant energy.

METEOROLOGICAL RADAR

Provides Forecasters with New Weather-Eye

MORE accurate weather forecasting is promised by radar techniques developed by the Aircraft Radio Laboratories at Wright Field. In one method, a 450-pound radar set is carried aloft in a weather reconnaissance plane. The radar operator scans the surrounding air and observes a picture of cloud formations on a special cathode-ray tube that indicates approaching storms at a distance of 100 to 200 miles. Ground radar sets also are used to locate storm thunderheads.

To obtain data on wind velocity and direction at various altitudes ground radar is used to track balloon-borne metal foil reflectors. These can be traced in their ascents to as high as their bursting point about 100,000 feet above the ground. Visual observation of the balloons the technique usually employed, is impossible at this altitude and wind data in the stratosphere cannot thus be obtained. With the radar method, the pulsed beam transmitted by the radar is reflected by the metal foil back to the receiver on the ground. The distance of the target is shown on the cathode-ray tube and the direction is obtained from the elevation and azimuth bearing of the radar antenna. Speed and direction of the wind can then be computed.

CARGO CONTAINER

Adds Four Tons to Transport Plane Capacity

THE Lockheed Constellation ordinarily carries a better than "respectable" passenger and cargo load at its cruising speed of 300 miles per hour. Now with a so-called Speedpak mounted under the fuselage, it will be able to carry an additional four tons of cargo for flights up to 1500 miles in length. The Speedpak is a sleek, streamlined, all-metal cargo container with a built-in electric hoist, which fits snugly on the under side of the fuselage, and which can be lowered to convenient height for loading.

At terminals the Speedpak can be loaded with baggage or cargo within the terminal, rolled into position prior to flight, and quickly raised and locked into position. The cargo container is 33 feet long, 7 feet wide, and 3 feet deep with a total volume of 395 cubic feet. Weight empty is 1700 pounds, while with top cargo load its gross weight is 10,000 pounds.

Ten mile per hour speed decrease is the only effect on the plane's performance

Cruising speed is not decreased more than 10 miles per hour when the container is in place and the interior capacity of the fuselage for either passengers or cargo is in no manner disturbed. Conversion from service with the Speedpak container to normal operation without only takes two minutes.

METAL FATIGUE

Is Caused by Crystal Juncture, Metallurgist Claims

A NEW CONCEPT of the fundamental reason why certain metals get "tired" and fail from fatigue—one of the oldest and most baffling problems in mechanical science—has emerged from research conducted by H. O. Walp, chief metallurgist for SKF Industries.

The fatigue phenomeon—the strange behavior of metals that results in their break-down under repeated stress—accounts for more failures in modern engineering practices than any other single factor. No fundamental theory of fatigue is yet universally accepted, despite the fact that research on the problem has been going on for generations.

The puzzle, Walp explains, is this: What happens to the properties of a steel object, like an automobile axle or ball bearing, that causes it eventually to crack in a certain spot when placed under repeated stress?

The metallurgist believes he has found the answer, at least with respect to extremely hard steel normally used in the manufacture of high-precision bearing. He explains it this way:

"Steel, like all metals, is crystalline. In the carefully heat-treated parts of bearings these crystals are extremely minute, but they are still crystals.

"The cohesive forces are stronger within any one crystal than they are across the boundaries of adjacent crystals. It seems reasonable to conceive points where two, three, or more crystals meet and where the cohesive forces are particularly weak.

"In a running bearing, the maximum resultant stress is a little beneath the surface of the race, or rolling member. If such an unfortunate crystal juncture happens to be in this area of maximum stress, it may furnish the starting point for a fatigue crack."

LOW-COST OXYGEN

May Soon Be Available In Great Quantity

NEW PLANTS for the conversion of natural gas to liquid fuels will create new demands for huge quantities of oxygen at high concentration, yet not quite so pure as the cylinder and liquid oxygen now regularly produced. The need for oxygen in this Synthine process is giving first impetus to the construction in this country of plants to produce oxygen of 95 percent purity at a rate of several-score tons per hour. The first two units are each expected to produce some 42 tons per hour (more than a million cubic feet) at hitherto unattainable low costs.

Success of this first installation now planned for Brownsville Texas, will be watched with special interest by blast furnace operators and producers of sulfuric acid, since concentrated oxygen available at the expected low costs would materially enlarge outputs of their plants and thus reduce their costs.

New Products and Processes

SALVAGE TOOL

Enables Split-free Reclamation of Lumber

Expected to find special favor with contractors and builders is a tool for use in the redemption of old lumber in razing jobs. Thus far, in tests to which it has been subjected, it has proved successful in the split-free removal of sheathing, siding, flooring, and other lumber. Known as Bord-Pri, the tool lifts lumber with such care that no cracks, splits, or breaks occur to lower its re-use value. Even adjoining pieces of tongue-and-groove flooring and shiplapped siding can be picked up without damaging them.

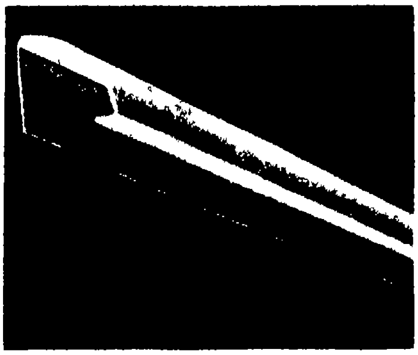
When butted against the boards to be removed, this tool, produced by the Maco Corporation, hugs adjacent studding and the extended lip supports it for positive leverage when pressure is applied to the handle. The equal distribution of pressure by this leverage action lifts the entire end of the board with no splitting or cracking.

Lumber salvaged with minimum effort

STEEL BASEBOARD TRIM

Is Decorative Raceway For Low Potential Wiring

A steel quarter-round, ¾ inch by ¾ inch, which serves as a baseboard trim, as a raceway for low potential wiring, or as trim for standard Plug-In Strips, is installed without the use of nails, screws, or fasteners. Projecting down from the back of the quarter round at three-inch intervals are integral steel prongs. When installed, these prongs are pushed down behind the baseboard or the Plug-In Strip, their design and positioning exerting a tension that holds the quarter-round snugly in place. Known as Lopo-Trim, it is produced by National Electric Products Corporation in six-foot lengths for rounding external or internal corners, eight inch by eight inch two-piece matching elbows are available.



Quarter-round conceals wires

Lopo-Trim has been approved for use as telephone wire raceway. It can also be used as a raceway for such other low potential services as buzzer and inter-communication wiring.

ELECTRONIC ALARM

Can Sound Warning at Many Points, Simultaneously

Prevention of loss of life in hotel and other fires is possible through the use of an electronic means of transmitting emergency warnings to all necessary locations instantly. This communication system, known as Comtone which utilizes the electric light wiring to carry music, announcements or fire alarms to each room of a hotel or similar building, is wired to reproduce the radio programs of four major networks, and also to provide a fifth "silent" channel which is always kept open and instantly available for emergency warnings or other messages. Even when the receiver is apparently turned off, this fifth channel is actually open, and through it can be broadcast a fire warning, giving the guests directions for escaping. In the time it would take a switchboard operator to telephone an alarm to one room, the entire hotel could be alerted to the fire danger by the use of Comtone.

PETROLEUM RESIN

Forms Quick-Drying Coat on Hard-to-Paint Surfaces

Known as A-resin, a new synthetic surface-coating which can be successfully applied to iron, brass, bronze, aluminum, and highly polished metal, in addition to wood and steel, has excellent qualities of adhesion, flexibility, and wetting power which particularly fit it for use on surfaces difficult to coat with ordinary paint. As a baked priming coat on automobiles it is hard, durable, light-fast, and chemically resistant. An A-resin can-coating that is only 2/10,000th of an inch thick remains unbroken even when the metal sheets are stamped and punched. This petroleum derivative withstands the pasteurization treatment of 20 minutes under 15 pounds of steam pressure at 250 degrees, Fahrenheit, and is unaffected by the extremely high acidity of grapefruit and certain other canned fruit and vegetable juices. A-resin pigmented films air-dry quickly, have good light stability, and retain a high and lasting gloss.

It also promises good results if used as a base for textiles, footwear, and rubber adhesive.

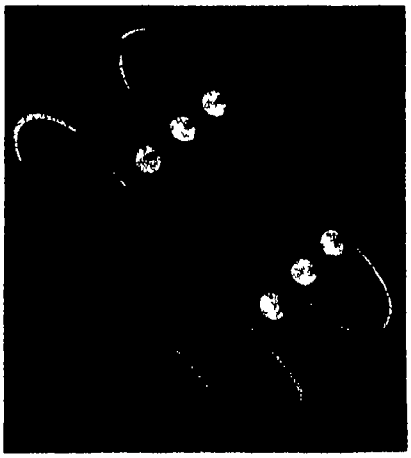
A-resin was developed by the Standard Oil Company (New Jersey) to sell at prices that compare most favorably with other synthetic resins. It is a short-oil-length resin, which means economy of drying oil.

There are several types of the resin, and a fair-sized plant soon will be producing the new material in commercial test quantities.

PLASTICS RIVETS

Are Clinched Without Shock

When used on fragile materials, acrylic fasteners, developed by the Douglas Aircraft Company, can be clinched without shock by simply heating and expanding the rivets with air pressure. After forming a strong, durable bond, the exposed parts of the rivet may be turned into novel decorative effects by further heat application and forming the plastics into a variety



Available in a wide variety of colors

of shapes Both solid head and hollow shank rivets can be made by the new process. The heat-expansion method of insertion allows the shatter-resistant rivets to be used as "blind" fasteners where only one side of the assembly is accessible If a rivet is found defective after fastening, it may easily be withdrawn by heating the flattened end with a hot rod, reducing the end to the original shank shape If desired, rivets may be redriven

Since the new Plexiglas rivets will not rust or corrode, they are ideal for use in radio or high-frequency apparatus or in food containers where metal cannot be used. Their feather-lightness (half the weight of glass) plus their clarity offers a new type bonding in decorative applications Plexiglas rivets are available in a wide variety of colors, ranging from light tints to deep tones, permitting manufacturers to match product colors

ROUGHNESS TESTER

A New Aid in Rubber Production

SCIENTIFICALLY measuring roughness, a property left previously to visual estimation, a device called the Rugosimeter is a development which promises to be of great use to the rubber industry When sheets of rubber are rolled out for production of rubber footwear and other products, their surfaces are often too rough and buckled for use The Rugosimeter, by giving a measure of this processing defect, will help determine and eliminate the causes

Guesswork eliminated by the accurate evaluation of sheet surface textures

After many years of developing rubber testing devices, the United States Rubber Company presents the roughness tester as a new step toward making rubber technology a precise science

It operates by measuring the resistance to the passage of a stream of compressed air between the rough surface being tested and a smooth plate resting upon it If the rubber surface is rough, the air passes easily through the "valleys" If the surface is nearly smooth, the air has difficulty in getting through The resistance to the passage of air through these irregular channels is measured by comparison with the resistance offered by an adjustable needle valve

CHEMICAL FEEDER

Reduces Troubles In Water Systems

COMMERCIAL, institutional, or industrial establishments having corrosion or scale difficulties in their hot-water or cooling-water systems—whether using 13,000 or 1 000,000 gallons per month—will find an answer to their problems in one of a series of feeders by which Micromet, a scale- and corrosion-control chemical, can be fed into the water lines with simplicity and low cost The feeders hold up to 20, 50, or 100 pounds of Micromet at one charge The chemical dissolves slowly, at a rate of 25 percent per month, so that only that much of the initial charge needs to be renewed each month

Water treatment unit disassembled

The amount of chemical required, and the size of feeder, depend on the type of water trouble encountered and the amount of water to be treated For corrosion, the 50-pound feeder, for example, will handle up to 150 000 gallons of water per month For hard waters producing lime-scale it will handle up to 300,000 gallons The larger feeder, according to Calgon, Inc will handle up to 1,000,000 gallons of scale-producing water per month, while the smaller type of feeders will handle as low as 3000 gallons per month

RADIUS BRAKE

Forms Low Ductile Materials Without Danger of Fracture

DESIGNED specifically for the precision-forming of duraluminum, chrome molybdenum, rust-resistant and spring alloys, and various other low ductile materials, a newly developed radius brake reduces the possibility of fracture or disintegration at the line of forming Easily-changeable forming bars with established radii of 0, 1/16, 3/32, 1/8, 5/32, 3/16, and 7/32 inch are available with this unit

With great versatility of operation, this brake, developed by the O'Neil-Irwin Manufacturing Company, can be easily adjusted to produce an almost unlimited variety of shapes, improved gages, supports, and clamping devices insure precision of forming With all levers conveniently located, and with roller-bearings installed, operator fatigue is kept to a minimum

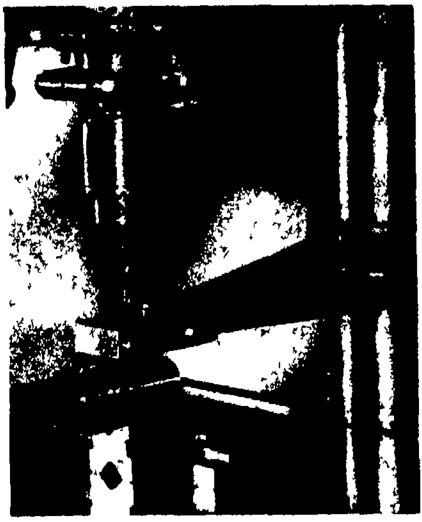
Easily adjusted for increased versatility

When this newly designed brake is used with the manufacturer's shears and benders, complex precision parts may be formed out of plain sheet metal on a production-line duplication basis, without the use of dies The shears, benders, and brakes are all available in a wide variety of sizes and capacities

DRILL PRESS ADAPTER

Permits Accurate Drilling Without Jigs

ADAPTABLE to the column of most small, popular-make drill presses, an aluminum alloy attachment displaces all but the most complex drill jigs inasmuch as it firmly and accurately holds interchangeable drill bushings close to the work Perfect alinement of spindle, column, and adapter is accomplished through an eccentric aiming bushing in the adapter head which when once set needs no further adjustment Filler bushings cover the range up to ½ inch



Will fit most small drill presses

Stops to locate the piece to be drilled are attached to the press table or directly to the adapter As the work is not enclosed, chip interference is entirely avoided This tool supplies a rigid bushing support to the drill or end mill in addition to the spindle chuck, thus preventing any inclination of the drill to drift, before or while drilling Chattering in milling operations is eliminated for the same reason Such accurate control of drills is attained with this attachment, made by Aetna Manufacturing Company, that overlapping holes can be drilled without punch marks and without any indication of run-out This has been done with a drill as small as 1/32 inch in diameter, and 1/4 inch holes can be drilled more than six inches deep with as little as 006 inch drift

PAINT BRUSH LAUNDRY

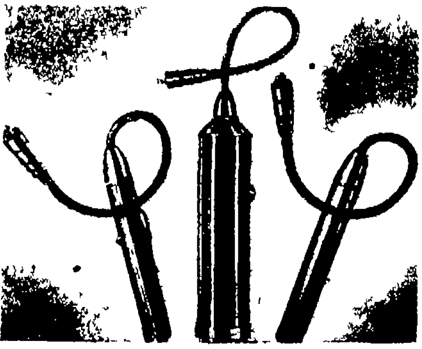
Reconditions Brushes Without Chemicals

Removing all caked paint from bristles and heels, refinishing handles and ferrules, and reshaping bristles, a paint brush reconditioning service claims to be able to restore even the most hopeless looking brushes The process used in restoration by the Strauss Paint Brush Laundry, originator of the service, envolves no soaking or harsh chemicals, and each brush is marked to prevent mixup Repairs on brushes with loose bristles, or damaged ferrules or handles, are done at a slight extra cost, and brushes mailed to the plant (pick-up service is available in the New York metropolitan area) will be returned, reconditioned, in approximately two weeks

FLEXIBLE FLASHLIGHT

Illuminates Work, Leaves Hands Free

With its bulb mounted on the end of a flexible metallic tube, a new flashlight throws a brilliant, uniform light into otherwise inaccessible areas The tubing can be bent at any angle and will remain in the adjusted position, or it can be wound around a pipe or rod, leaving hands completely free. The flashlight, made by the Holub Industries, Inc, uses standard bulbs and batteries, and is available in three sizes



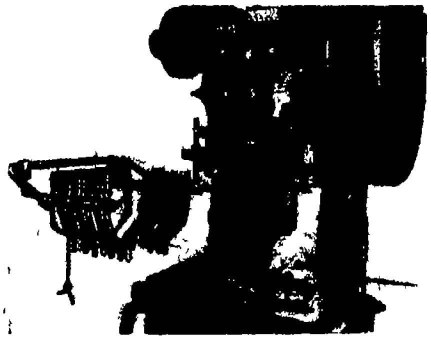
Holds position to which it is bent

PRESS SHIELD

Protects Operator, Does Not Obstruct Work

Custom built to fit power presses used in blanking operations, a new safety guard, has a transparent Plexiglas shield located near the front to provide the press operator with an unobstructed view of the blanking operation Since the plastics shield is shatter-resistant and splinter-proof it also protects the operator from flying metal particles Called the Junkin Swinging Die Closure, the guard is mounted in an adjustable frame permitting horizontal movement to accommodate any change in power press operation If necessary, the plastics shield may be swung up and out of the operating position to allow adjustment of the power press The guard also permits easy, safe access to the dies when necessary

Guard in operating position



Shield swings, gives access to die

CASEIN BRISTLES

Look Like Nature's, But Cost Less

Successful commercial application of its development for making bristles from casein, has been announced by the United States Department of Agriculture Research on the new product was initiated four years ago to find a suitable substitute for imported natural bristle

The artificial bristle is made by extrusion of a mixture of casein and water through a suitable die, and then subjected to finishing operations The final product is round in cross section and has a black color comparable to that of horsehair or pig bristle Like other artificial fibers, it can be produced in any length desired and in a range of diameters Of many possible uses, the low-cost bristle is particularly adapted to the construction of paint brushes since it is resistant to oils and organic solvents

Casein from waste skim milk is the main constituent used in making the bristle product, but it is possible that other protein materials derived from agricultural commodities may also be employed

WELDING ELECTRODE

Makes Welding of Special Steels Practicable

To simplify the welding of high-sulfur, free-machining steel, and of certain high-tensile, low-alloy steels, a new electrode, known as Shield-Arc LH-70, has a low-hydrogen, low-moisture coating and is designed for use with D C

Welding currents used are high in comparison with other all-position-type electrodes, and the electrode makes possible a weld in less time, according to The Lincoln Electric Company Pre-heating of high-tensile, low-alloy steels can be eliminated or largely reduced, it is said, and welds of exceptional toughness can be made on high-carbon and other steels which tend to show under-bead cracking when welded with the usual type of electrodes Also, welding high-silicon electrical sheet steel is practicable with the new electrode and high-sulfur steels can be welded as readily as low-sulfur mild steel

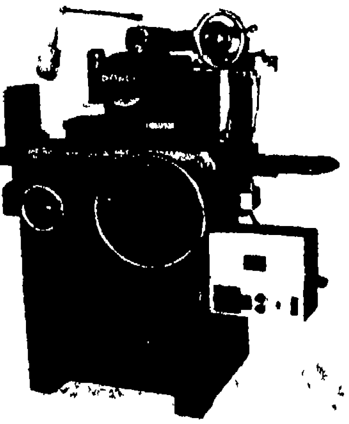
An interesting application for the electrodes is seen in the arc welding of materials to be enamelled Where it was formerly necessary to heat-treat the vessels after welding to drive out the hydrogen in order that the enamel would not bubble and peel, enamelling may now be done without heat treating

SURFACE GRINDER

Is Manually Controlled for Working to Close Tolerances

Hand operated and featuring smooth, easy table action, a new grinder has hardened gears running in needle-bearings and driven by a 16 inch hand wheel The one-inch cross-feed screw located in the center of the saddle assures smooth, accurate, cross-feed action The grinder has heavy, deep "V" ways between the saddle and base, and one flat way between the table and saddle All ways are hand scraped and a gravity feed oiling system lubricates them

Another feature of this grinder is the cartridge type direct-drive spindle as standard equipment This spindle has precision ball-bearings throughout,



For precise specialized grinding

with automatic take-up for wear The direct coupled one horsepower motor and the spindle itself are statically and dynamically balanced, and are totally enclosed This hand operated grinder, a product of the Do-All Company, is designed for tool rooms requiring special grinding operations to extremely close tolerances

QUICK-CHANGE BITS

Employ Same Shank For All Size Borings

SPEEDING and simplifying the process of changing bits, a new set of wood-boring tools consists of one shank and a number of changeable boring heads In use, the operator simply loosens a set screw and inserts the desired size quick-change boring head The head locks securely with a positive-seal precision fit, the set screw acting merely as a safety lock

Even when boring the hardest woods the new-type bit requires no forward pressure This is made possible by the extra long cutting edge of the boring head and by the specially designed lead screw which actually pulls the tool through the wood There are no flutes to bind or clog The boring heads are made of high carbon tool steel, heat-treated to assure long life, and are easily sharpened The smooth, fluteless shank of heat-treated chrome-moly steel permits drilling of exceptionally deep holes, and the long lead screw with its diamond point eliminates splitting This new bit, made by Bruno Tools, bores easily on an angle and is particularly well suited for cutting dowel and bolt holes

Boring heads are changeable

FORMALDEHYDE POLYMER

Serves as Plasticizer, Solvent, or Fuel

TRIOXANE, a polymer of formaldehyde useful in a wide variety of present-day industrial applications, is now available for commercial distribution Although discovered in 1885, it wasn't until very recently that a practical process for its manufacture on a commercial scale was developed Trioxane, now produced by E. I du Pont de Nemours and Company, Inc., is a colorless, plastic, crystalline solid A sweet odor, resembling that of chloroform, is a distinctive characteristic of trioxane, with no trace of the formaldehyde odor remaining It ignites instantly and burns with a very hot, non-luminous, clean, odorless flame, a property which suggests its utility as a packaged fuel for campers, picknickers, and hunters

Readily soluble in alcohols, ketones, ethers, esters, chlorinated hydrocarbon solvents, and aromatic hydrocarbons, trioxane, in molten state is itself an excellent solvent for many organic substances, including phenol, naphthalene, vegetable oils, fatty acid amides, urea, and, in the presence of water, the protein, zein These properties indicate the usefulness of trioxane as a plasticizer of other materials in cases where its volatility is not objectionable Trioxane-zein compositions, for example, are believed to present many potential applications in coatings and as plastic aggregates

Its solubility in most types of organic materials makes possible the use of trioxane as an intermediate in organic reaction media In such anhydrous media, trioxane is stable if the system is neutral or alkaline Small amounts of strong acids or acid-forming substances cause the compound to depolymerize to monomeric formaldehyde at a rate that may be readily controlled by regulating the amount of catalyst and the temperature

By this means, trioxane added to a reaction mixture forms a system that is stable until the required catalyst is added to cause depolymerization The properties of this new product make

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Stock #824 S 7 x 50 Metal Parts $35 00 Postpaid

OPTICS—Set includes all Lenses and Prisms you need for assembling 7 x 50 Binoculars These Optics are in excellent condition perfect or near perfect — and have new low reflection coating
Stock #5102 S 7 x 50 Optics $25 00 Postpaid

NOTICE! If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20% Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled

ARMY S 6 x 30 BINOCULARS
No Carrying Case with any Sets shown below (None yet available in Surplus Market) M 13A1 sets are waterproof model M 3 sets are not waterproof Limit — 1 set to a Customer on all Sets shown below

COMPLETE OPTICS & METAL PARTS — Model M 13A1, 6 x 30 Binoculars Everything you need ready for assembly When finished will look like a regular factory job costing $102 to $120 The Optics are new in perfect or near perfect condition Have new low reflection coating Metal Parts are new and perfect all completely finished No machining required Bodies factory hinged and covered Complete assembly instructions included
Stock #830 S $40 00 Postpaid
plus $8 00 tax — Total — $48 00

COMPLETE OPTICS & METAL PARTS — Model M 3 6 x 30 Binoculars The Optics in this set are new perfect or near perfect Prisms have new low reflection coating Factory mounted Eye Piece and Objective Assemblies not coated Metal Parts are perfect new ready for assembly When finished this will look like a regular factory job except a name has been filed off a cover plate No machining required Bodies factory hinged and covered
Stock #831 S $35 00 Postpaid
plus $7 00 tax — Total — $42 00

METAL PARTS ONLY — Model M 13A1, 6 x 30 Binoculars No Optics Same Metal Parts as described for Stock #830 S
Stock #832 S 6 x 30 Metal Parts $25 00 Postpaid

METAL PARTS ONLY — Model M 3 6 x 30 Binoculars No Optics Some machining on these Metal Parts required Bodies hinged and Prism Shelf holes placed but you must tap them Prism Shelves have been machined Six lead spiral focusing threads have been cut Some less difficult components you must thread and machine yourself but all material you need is furnished except body covering material and Optics
Stock #833 S 6 x 30 Metal Parts $12 00 Postpaid

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METAL PARTS ONLY — Model M 3, 6 x 30 Binoculars No Optics All parts you need You must do machining on most parts but not all No body covering material
Stock #834 S 6 x 30 Metal Parts $8 00 Postpaid

OPTICS FOR 6 x 30 BINOCULARS (No Metal Parts) Slight seconds Cemented but not coated
Stock #5123 S $10 00 Postpaid

SAME OPTICS AS Stock #5123 S (6 x 30) but coated
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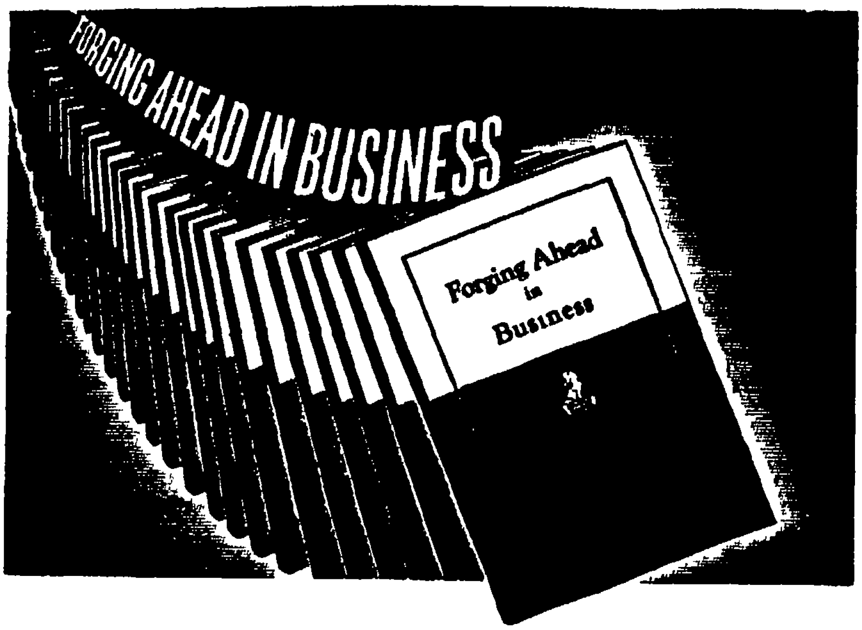

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possible its use as a source of formaldehyde for reaction with various materials In many cases trioxane gives more positive control of reaction, improved quality and uniformity of the end product, better yields, shorter reaction time, and a generally smoother overall reaction than can be obtained by the use of aqueous formaldehyde solutions or other formaldehyde polymers

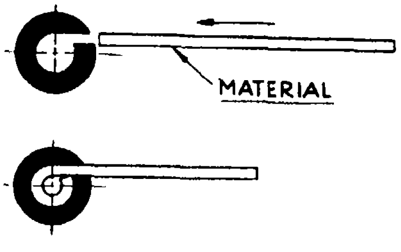
LONG-LIFE DIE

Turns Out Loops With Minimum Wear

A forty-fold increase in die life and the elimination of practically all maintenance is reported to have resulted from the use in one plant of carbide dies for the forming of loops on small hinges The forming die is a simple bushing of Carboloy Grade 883, a carbide combining toughness with high resistance to abrasion and wear A slot, sufficiently wide to clear the thickness of the work piece, was cut in the bushing, as shown.

The hinge blanks—of cold rolled steel—are fed into the die by a press, forming the loop on one end of the hinge, inside the die The finished piece is ejected sideways out of the die, and the cycle repeated

The particular Carboloy die used has turned out more than 1,000,000 looped hinges without exhibiting any detectable signs of wear, according to latest production reports Hardened steel dies of similar design formerly used for this operation had to be completely re-built after looping an average of 25,000 pieces



Cold rolled steel blank is shaped to loop on a wear-resistant carbide die

VINYL PLASTICS

Offers Durability, Long Life for Coated Fabrics

One of the co-poly vinyl compounds, a new plastics is adaptable to use on any woven fabric, or for coating leather and other smooth finish, flexible materials Odorless and slow-burning, the plastics, called Texflex, has a high resistance to salt solutions, acids, alkalis heat, light, and aging For this reason, it is believed to have a wide application potential in both industrial and home use

The compound may be applied by dipping, roller coating, knife coating, brushing, or spraying Its minimum tendency to string or cobweb makes it possible to obtain a relatively uniform surface with any method of application The best results, however, have been obtained by spreading Texflex on the material and wiping off the excess with a "doctor blade" Both waterproof and washable, the vinyl is manufactured in a wide range of colors by the H V Walker Company A clear compound is also available Adaptable to flash or infra-red baking, the material combines a wide range of flexibility with excellent strength It can be punched, cut sewn, or creased without breaking the vinylite seal

PNEUMATIC SCREW DRIVER

Drives Screws Rapidly,
With Little Effort

Designed especially for fast driving of small screws, a pneumatic screw driver is valuable wherever driving is to be done on a production basis Weighing only eight ounces, the screw driver fits easily into the hand, and operator fatigue is extremely low A special feature is the pneumatic pick-up, which enables the operator to pick up screws and drive them directly into the work, eliminating entirely the time lost by the operator fumbling with small hard-to-hold screws

Fumbling with tiny screws eliminated

The screw driver, manufactured by the Keller Tool Company, is available in two models, one of which drives free running-screws up to Number Three, and very small wood and self-tapping screws, it operates at 2500 revolutions per minute The other accommodates screws from Number Three to Number Six and operates at 10,000 revolutions per minute

MIDGET HYDRAULIC PUMP

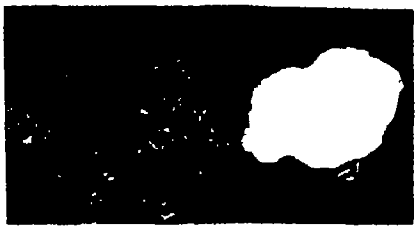
Is Light and Small, Yet
Has High Efficiency

Developing 5000 pounds per square inch, yet small and light enough for a boy to handle, an hydraulic pump has a single bank of plungers which deliver three gallons per minute at 1800 revolutions per minute, and two gallons per minute at 1200 revolutions per minute Manufactured by the Superdraulic Corporation, the pump has a high volumetric efficiency—95 percent with the lightest hydraulic oils—and should prove a convenient means of hydraulic power application to machinery where space is at a premium and yet where the flexibility and perfect control afforded by hydraulic power is desirable It is particularly adaptable as a holding pump for presses and plastics injection-molding machines, although it may also be used as a powerful reversible hydraulic motor

ENAMEL REMOVER

Strips Synthetic Finish
Without Damage to Surface

Slightly viscous, a preparation that can be brushed, sprayed, or applied by dipping, will remove synthetic enamel from all types of surfaces, including wood and metal. It contains a non-waxy evaporating retardent that keeps the remover on the work until its stripping action is completed Stripping is accomplished by a wrinkling action so that the enamel can be brushed, wiped, or scraped off No waxy residue is left to interfere with adhesion of subsequently applied finishes



The remover's wrinkling action is apparent after only 30 seconds' application on an alkyd enamel coat (left) Stripped surface (right) needs no further finishing before being re painted

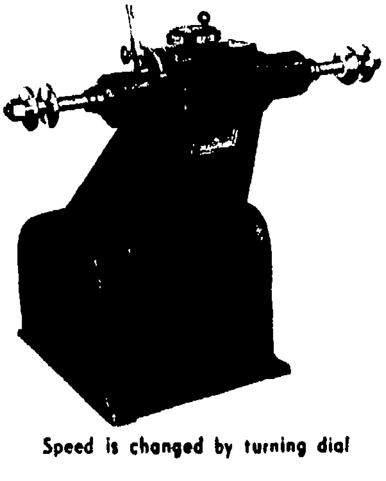
The remover, a product of Enthone, Inc, will strip certain nitrocellulose coatings, but it is not satisfactory for linseed oil paints, phenol-formaldehyde enamels, or vinyl type coatings Modified urea-formaldehyde, melamine, and alkyd coatings are rapidly stripped however, and the remover, known as Enamel Stripper S-45, has no harmful action on metals, plastics, or wood

VARIABLE-SPEED LATHE

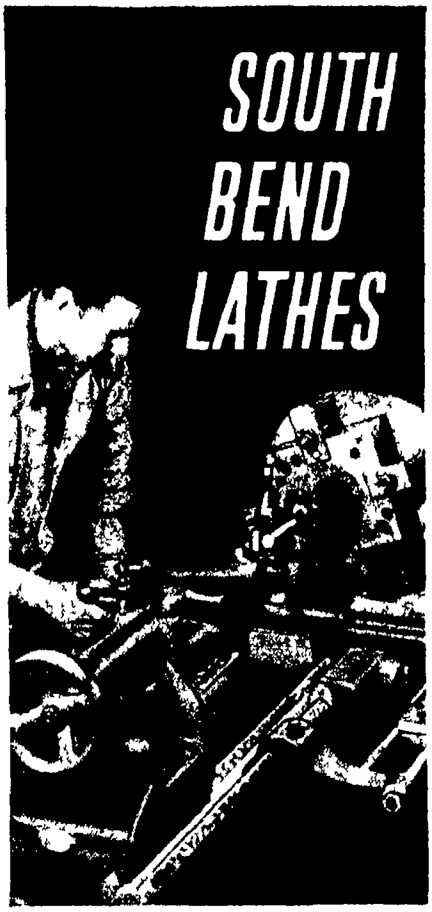
Is Easily Controlled
Without Interrupting Operations

A single spindle buffing lathe—suitable for color buffing, light cut buffing, and polishing—features a variable speed control which permits instant change of speeds within a range of from 1500 to 3000 revolutions per minute, while the lathe is running The speed change is accomplished by turning a dial which raises or lowers the motor, and causes the movable disk on the variable-speed pulley to slide laterally, thereby increasing or decreasing its pitch diameter and changing the spindle speed A single wide V-belt is used for drive from motor spindle, and the spindle overhangs the base eight inches to permit handling bulky parts

Standard equipment with the lathe, manufactured by Hammond Machinery



Speed is changed by turning dial



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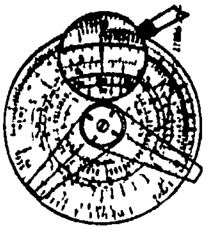

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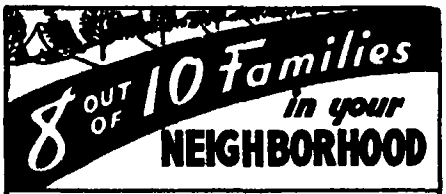

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Builders, Inc., includes a three-horsepower, 60-cycle motor, although motors of other specifications can be supplied on special order

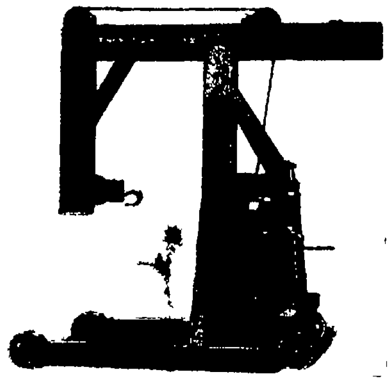
PORTABLE CRANE

Has Folding Feature, Clears Low Overhead

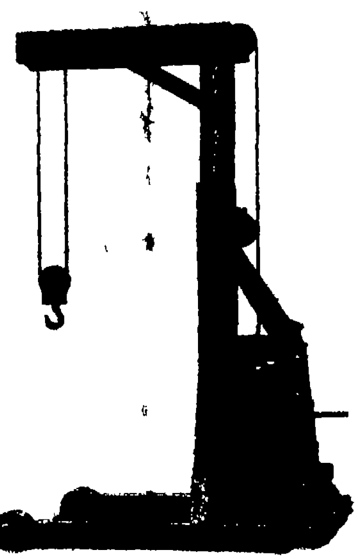
So designed that the upper part may be folded down to permit moving it under low doorways or other overhead obstructions, an ingenious portable crane is being produced by Revolvator Company The folding feature, which also facilitates shipping in more compact form, is effected by the same crank and cable that is used for hoisting material To place the crane in upright or extended position ready for operation, it is only necessary to wind the cable on the drum by means of the crank till the pulley at the lifting hook is against the frame, and then keep on winding until the crane assumes its upright position. Pins are inserted through the stationary and movable frames to lock the parts in place To lower the crane, the hook is first raised to the top, then the interchangeable crank handle is placed on the brake shaft, the locking pins are removed, and the crane is lowered to the folded position slowly and gently by relieving pressure on the brake drum through the crank

The crane is equipped with a low gear for lifting very heavy loads, the crank handle is placed on the center shaft or lower shaft according to the weight to be lifted Maximum capacity of the Revolvator portable crane is 4000 pounds

The Revolvator crane is equipped with a floor lock and the steering handle is geared to the front wheels which turn easily on Timken roller bearings



Folded frame facilitates moving

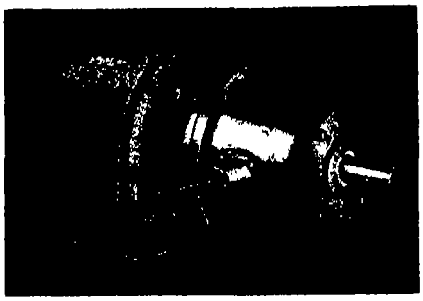


Upright position of folding crane

TRANSMISSION UNIT

Gives Ratios Not Available In Two-Speed Motors

Offering special ratios not obtainable with regular two-speed electric motors, a new transmission unit provides direct motor speed, a neutral point, and one reduction Standard reductions are 1½ to 1, 2 to 1, 3 to 1, and 4 to 1, although reductions up to 6 25 to 1 are available Units can be swiveled about on the mounting flange so that the automotive-type gear shift lever may be in any one of three different positions, 90 degrees apart (two horizontal and one vertical) In the larger sizes these transmission units, produced by the Western Manufacturing Company, are made with modified base mountings, corresponding with the legs of the motor frame



Three mounting angles possible

PLASTICS BOTTOM-PAINT

Emits Poison, Prevents Marine Growths

Capable of saving annually an estimated $4,500,000 on hull repairs, dry docking, and painting costs for ship and boat owners in the United States alone, a cold-plastics bottom-paint has been developed which effectively prevents the growth of marine life After two years of extensive research and large-scale testing, Manning-Mitchell, Inc, have presented evidence that the paint will completely eliminate all forms of marine growths for from 18 months to two years The outstanding feature of the cold-plastics paint is the controlled leaching whereby its poison content is emitted at such a rate that development of marine growths is impossible

SYNTHETIC-COATED CORD

Possesses Unusual Strength And Resistance to Weather

Made of a flexible synthetic, a recently developed Koroseal cordage is composed of 19 strands of low-stretch cord rayon with high tensile strength, jacketed with a generous coating of white Koroseal The product has all the good characteristics of the best quality cotton cordage of 150 inch diameter, plus a number of advantages

According to the manufacturer, The B F Goodrich Company, these features include tensile strength of 150-200 pounds, non-kinking and non-twisting, wipes clean with damp cloth, excellent resistance to abrasion, no reduction in tensile strength after 200 hours water spray and weathering test at 125 degrees, Fahrenheit, no significant change in characteristics after oven test for 48 hours, very slight shrinkage in water boiling test of 24 hours, withstands sub-zero weather if not abruptly kinked, ties and knots same as cotton cord, jacket withstands clinching or bending pressure with all types of hooks or fasteners

SAFETY GLOVES

Have Built-In Non-Skid Surfaces

A ROUGH finish on the fingers of synthetic rubber gloves, known as Griptite, prevents wet slippery materials from skidding out of workers' hands Developed by the Surety Rubber Company, the finish is a part of the glove, and cannot rub or peal off, nor will particles drop off in liquids Rubber gloves with Griptite finish are available in the standard sizes and styles with either curved or straight fingers

Available in standard sizes

BOTTLE CARRIER

Prevents Injury from Splashed Chemicals

LIGHT-WEIGHT and shock-proof, a new bottle carrier is designed to prevent accidents and severe burns caused by dropping glass bottles containing harmful chemicals, as well as cuts from flying glass

The protective bottle carrier, a product of the United States Rubber Company, is available in a gallon size and a five-pint or two-liter size The outer bag is made of heavy duck, impregnated on both sides with chemical-resistant synthetic rubber All seams are vulcanized Carrying straps of double thickness run completely under the carrier so that the load is properly distributed and supported. A locking device on the drawstring keeps the carrier closed and prevents splashing

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Acid proof and fully padded

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COMBINING plate and frame in one casting, a stack filter press of cast iron, developed by the Youngstown Miller Company, enables quick and easy cleaning and removal of cakes through an individual latching arrangement of each frame Starting with the top frame, each section is individually latched in an elevated position to permit the filter paper and cake to be pulled forward out of the press The cake is quickly removed and the filter paper replaced Frames are then re-lowered into position and tightened by a hand screw, forming a tight press

Each frame individually latched

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(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below)

American Standards This revised price list, covered in 24 pages, contains listings and prices for 864 standards approved for national use of industry by the American Standards Association—many of them developed under war procedure and approved for peace-time use This list includes specifications for metals and other materials, methods of work, and methods of test for finished products Also included are listings for public and industrial safety, industrial medicine, and a wide variety of consumer goods *American Standards Association, 70 East 45th Street, New York 17, New York—Gratis*

More Power to the U.S.A In 32 pages this bulletin presents the Allis-Chalmers products commonly used on generating, substation, transmission, and distribution systems *Allis-Chalmers Manufacturing Company, 708, Milwaukee 1, Wisconsin—Gratis*

Transport Coordination in the United States, by P Harvey Middleton, Executive Vice President, Railway Business Association A scholarly, concise, and clear report on the subject of transport coordination In 72 pages Mr Middleton defines coördination as now permitted by law, describes many coordinated services, and discusses dispassionately what further coordination of rail, bus, air, and truck might be desirable for the national economy, without danger of monopoly *Railway Business Association, 38 South Dearborn Street, Chicago 3, Illinois—Gratis*

A Better Kind of Lighting. In this four-page bulletin nine types of reflector lamps for industrial, commercial, store, theater, and display use are described and illustrated Size, beam-spread, and application are listed for each type *Lustra Corporation of America, 40 West 25th Street, New York 10, New York—Gratis*

Radiomarine Shipboard Radar In 12 pages this brochure describes model CR-101, which is designed for commercial ships and large pleasure craft This model features the 3.2 centimeter super high frequency band and a compact antenna structure which gives 1 6 degree horizontal beam, resulting in pictures of exceptional clarity and sharpness on the 12 inch diameter cathode ray scope *Radiomarine Corporation of America, Department AP-10, 75 Varick Street, New York 13, New York—Gratis*

International Shipping Documents This is a four-page quick-reference publication designed to provide air-freight shippers to points outside the United States with a handy chart on documents required by various nations The first section describes documents required by the United States Government for export, including data on shipper's export declarations and export licenses The second section covers the import documents of 42 countries of destination, with information on consular invoices, certificates of origin, commercial invoices, and other special certificates *American Airlines, Inc, Cargo Sales Division, 100 East 42nd Street, New York 17, New York.—Request this publication on your business letterhead*

Die-Less Duplicating This 40-page profusely illustrated catalog gives complete information on equipment for producing, with die accuracy, sheet metal parts to individual specifications Much of the equipment described has been redesigned for even better and more accurate production It is useful in model-making shops, experimental laboratories, and production departments, where it replaces dies for both simple and complicated forming operations Request Catalog Number 46-11 *O'Neil-Irwin Manufacturing Company, 347 Eighth Avenue, Lake City, Minnesota.—Gratis*

New Improved Unitables This eight-page bulletin describes and illustrates several types of all-purpose conveyors which are really mechanized work tables for assembly, inspection, or packing operations *Island Equipment Corporation, 101 Park Avenue, New York 17, New York—Request this bulletin on your business letterhead*

Harnessing the Rainbow for You Published for teachers, students, and others with special interest in dyes and textiles, this 12-page booklet—in question and answer form—gives a short history of the synthetic dyestuffs industry and discusses the nature and uses of various types of dyes Methods of application and color fastness are included *E I du Pont de Nemours and Company, Inc, Advertising Department, Dyestuffs Division, Wilmington 98, Delaware—Gratis*

Hydraulic Pallet Lift Truck is an illustrated folder containing a diagram for recommended pallet construction, and information on methods of operation with pallets, showing the adaptability of various materials to palletizing Request Bulletin 220 *Lyon-Raymond Corporation, 3154 Madison Street, Greene, New York—Gratis*

Kriston Thermosetting Resin is a 12-page bulletin, punched for ring binder, which deals with properties and processing information on a thermosetting allyl ester casting resin *B F Goodrich Chemical Company, New Products Department, Rose Building, Cleveland 14, Ohio—Gratis*

Concrete Floor Maintenance Pays Dividends is a folder describing the results obtained by the use of Stontop, a surfacing compound which, it is claimed, will stop floor "dusting," and protect against the action of acid, grease, oil, and abrasion *Stonehard Company, 403 North Broad Street, Philadelphia 8, Pennsylvania—Gratis*

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The Editor

THE SOCIAL EFFECTS OF AVIATION

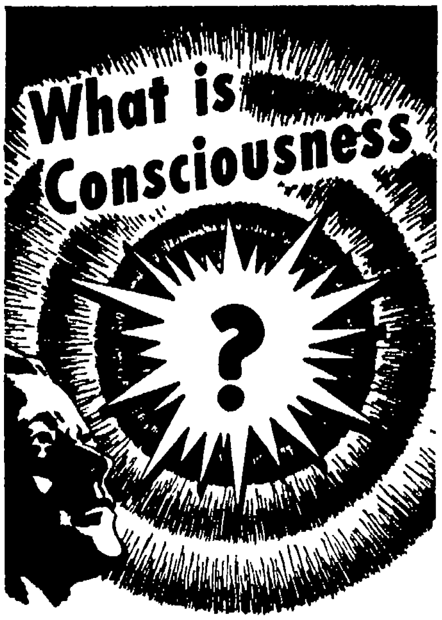
By William Fielding Ogburn, assisted by Jean L Adams and S C Gilfillan

A WELL-WRITTEN and thoughtful book which deals with many aspects of aviation and their impact on the life of the nation The book is unique because it is the first comprehensive effort to evaluate the social effects of aviation today and in the immediate future A few of the chapter titles will serve to indicate its scope Technology Brings Social Changes, A New Transportation System, On Predicting the Future, On Predicting the Social Effects of Invention, Technological Trends in Aviation, Schedule Transportation of Passengers, The Transportation of Goods, Landing Places, Flying Service to Small Places, Private Flying, Air Routes, International Travel, Social Effects (755 pages)—$5.20 postpaid—*A K*

PLASTICS BUSINESS

By Herbert R Simonds and Joseph V Sherman

CONSTITUTING a keen analysis of structure and trends of the rapidly expanding plastics industry, this book deals chiefly with business and statistical aspects Sales, profits, costs, production rates, methods, and many other intimate facts on the major plastics



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Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

CERIUM OXIDE and its relative, Barnesite, are now largely doing the work formerly done by rouge in the precision optical industry, though it is not likely that rouge will ever be abandoned The new materials are used mainly like rouge but there are some minor differences in working technique One reader of this department, Jacques Labrecque, 860 Dunlop Ave, Montreal 8, P Q, Canada, writes "I have hit a problem Every time I try cerium oxide it slowly regrinds my mirror What is the cause of this?"

This inquiry was referred to Fred B Ferson, Ferson Optical Co., Biloxi, Miss, who has used much rouge, cerium oxide, and Barnesite, and who offered the following suggestions "Maybe this worker has been putting too much cerium oxide on his lap with too little water and this use of too dense a suspension has caused the cerium to roll and enamel the glass This happens when there is too much cerium oxide (or, for that matter, any other polishing agent) either to become embedded in the lap or pushed off from it The enameled surface then has the appearance of a very fine, iridescent grind, the iridescence being caused by interference of light reflected from layers of different thicknesses An enameled spot on a mirror or lens is clearly visible in the Foucault test, both in outline and thickness The enamel is on the glass, not of it, and is only of the order of one wavelength in depth"

Cerium oxide is more likely to enamel than rouge, but not if properly used Therefore, the question of how much water and how much polishing material to use on a pitch lap may be treated as a single, general question of basic interest and usefulness to all glass pushers, amateur or other

As Everest has pointed out in "A T M A," if too much rouge is applied to a lap the mirror gets a long, free ride but not much polish Many beginners and not a few others slap on rouge much as a green mechanic squirts oil on and all over a bearing if a little is good, he thinks, a lot must be better However, it really is difficult to believe that a very little polishing material can do the work it actually accomplishes

Regarding the amounts of water to use in polishing there are two parties, the Wets and the Drys and, between them, a third party, the Moists "One way to polish," Ferson points out in describing the Wets, "is to use considerable water, weight the lap (I refer to machine system using sub-diameter polisher, lap on top), and accomplish the polishing by means of the weighting The opposite is to use a minimum of water and permit natural drag to take place, as it will do whether the work is weighted or not This develops squeals and some lens shops sound like a penful of pigs The main disadvantage of this Dry method is probable overheating of the surface, so that this method is not suitable for fine figuring, and another is the likelihood of producing sleeks (hairline scratches) These effects can, of course, be quickly adjusted at the end of the run by applying more water and continuing polishing a few minutes

"In production work," Ferson continues, "where many jobs are in progress at one time, one man can give attention to more laps where the wet method is used, since the dry method calls for addition of water and polishing agent drop by drop Once, in watching work in a spectacle-making shop, I saw the operator standing with a pail of rouge and a huge brush with which, after dipping it in the pail, he would flip rouge on the many spindles without moving from the spot—of course with great loss of rouge and the whole place painted red

"The enameling mentioned by the inquirer may also occur when the lap is not quite in contact at some point"

Standing between the Wets and the Drys are the Moists Your scribe once helped Dave Broadhead, Wellsville, N Y, a Moist, by doing the heavy looking on while he parabolized two 10" mirrors face up using a 5" lap on a modified Draper machine with Barnesite as the abrasive Having made several thousands of roof prisms in wartime, Broadhead must have learned a few things optical, so his methods may be worth studying

He put a spoonful of Barnesite in a drinking glass of water

With a fine artist's brush having only a few hairs he stirred this up

Then he shook the brush a little in the top of the still roily water to shake out possible grit.

Next he brushed a little of this mixture on the lap, which was a new one just made, and *this was to be the total polishing material used for the one or two hours of figuring spells*

He washed the mirror and set it on the machine, then washed his hands with soap, to avoid possible grit

Using his dried hands as a towel, he rubbed off nearly all the water adhering to the mirror, placed the lap on it, and started the machine

Soon a tendency to squeal developed, he was working as a Moist He worked throughout as a Moist, not a Wet. He sat beside the machine like a nurse at a bedside and, each time the pig showed first signs of squealing, he dabbed on a tiny droplet of water from the top of the now well-settled water in the tumbler

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Here was a constantly maintained nice balance between squeal and not-squeal—diligently keeping in Moist territory all the time To accomplish this the little droplets were added about once in 10 or 15 seconds on either side of the moving sub-diameter lap If you fall asleep at it the pig wakes you up.

Maybe faster ways could have been found to parabolize But isn't it better to find ways to stretch out the action? You are not so likely to barge into a bad situation and aggravate it before discovering what you have done Case of feeling your way and remaining always in full control What's an hour or two for parabolizing a 10" mirror?

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"My theory," Broadhead comments, "is to keep the lap and the work in extremely intimate contact. This cannot be achieved by adding whole gobs of water on one side, with the lifting and tilting thus occasioned. The aim is to maintain an unvarying and strong suction (attraction) Then, with an extremely stiff lap backing, great pressure is automatically exerted on the high zones The lap may squeal loudly at first but this subsides as the zones disappear"

A Wet uses much water and then adds much weight to squeeze it out. The Moist lets the forces of adhesion take care of this—and they are strong.

Shown copy on all the above and invited to correct any errors in it, Broadhead finds none but adds "My only criticism is that the reader may get the impression that the technique is advocated principally for small-tool parabolizing, whereas it is of greatest efficacy in getting the desired starting sphere, and is later helpful in obtaining a smooth and comparatively zone-free paraboloid"

Considering the number of optical Wets there are, the above discussion should have important impact on amateur optics.

The Dry, or squealing porker, method may develop unexpected heat elsewhere Your scribe, in polishing a mirror by hand with Barnesite, so highly perfected the "eeeeeeeeek" technique that feminine feet were wont to register violent objection by thumping on the floor above The pig kept it up—he had a devilish glint in his eye—and the cellar door next flew open and a large tin wastebasket came hurtling down the stairway A housebroken, domesticated pig, not a pigheaded pig, might have taken this as a faint hint, but this pig was trying to figure out just exactly what vibrates, and why, when a pig gets into a mirror Probably every mirror maker has discovered pigs in his mirror and wondered whether harm would result None, except on final figuring, where it makes too much heat. Don't let it go that far Don't, even,

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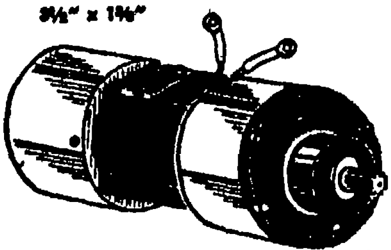

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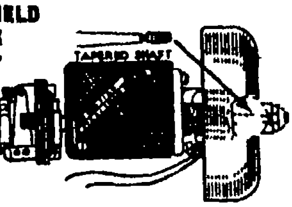

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"The general rule for any polishing materials," Ferson emphasizes, "is to apply only a small amount of polishing agent in a larger amount of water (a teaspoonful or tablespoonful in a glass of water), to forbear from adding more of the agent than the lap will handle, and not to try to hurry the action by adding more and more because this will not work.

"Just how much the lap will take up," he continues, "will depend on its hardness—the harder the less, until a very hard lap will take up none at all and will grind instead of polishing Even a very soft lap will take up only so much in a given time Toward the end of polishing, only water from the top of the glass, which contains the finest rouge, should be added."

LAST September this department announced that if as many as twenty five 16" Pyrex telescope mirror blanks could be ordered and molded at one pouring, the purchase price per blank would drop by about $100 This number of blanks soon were ordered and supplied to the users A large part went to professionals who took advantage of the opportunity, and their co-operation is welcome Some of these professionals formerly were amateurs

This department now receives belated word that nine more 16" blanks are wanted, two of these from a worker who put off sending his shekels to Corning Glass Works till too late to get into the earlier club Also, several who advised this department that they "had joined" apparently thought a mere expression of intention would serve, but Corning's mare won't go without the actual spinach. We now propose a 1947 "Sixteen-Inch Club" started off by the nine mentioned above Present price is

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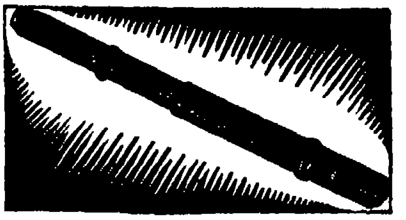

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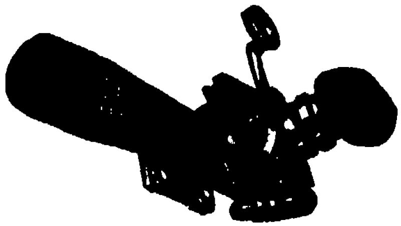

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How thick, how rigid, must the glass tool be on which a mirror is ground and polished? On this there have been two schools of thought One school says as rigid as the mirror, or almost. The other says rigidity makes little or no theoretical difference in a tool

This question came up when this department was asked whether Corning's ⅝" or ½" Pyrex "Panel Stock," cheaper than mirror blanks though of the same glass, could safely be used as the tool for a fairly large mirror, say a 12½" This stock is given standard commercial annealing but not the special annealing that mirror blanks rate The question was passed to a few advanced amateurs One replied "I've been using tools much thinner than that but haven't noticed any astigmatism" Another 'Used a ¼" tool on a 4¼" mirror No astigmatism" A third "I tend to side with the thin tool boys, provided the worker keeps rotating the mirror and circumnavigating the barrel" The last clause is the basis on which the thin tool school argument is based, but few appear to have risked loss of labor by making a planned experiment that would bring the answer out unequivocally, such as trying a 10" or 12½" mirror on a ¼" tool Goat wanted

You no doubt have made your formal will but, even then, what would your puzzled heirs know about disposing of your optical things? Pause and try to think out just exactly how mother, wife, or children would proceed with this job You are an angel hovering overhead but you can't make your presence known and you are thinking, "There go my best eyepieces for a dime apiece and that fine little flat for two cents while they are trying to get $100 for that worthless unfinished, unfigured, objective lens" You'd be thinking things no angel is supposed to think

Would it not be a kind, thoughtful thing to jot down in pencil some informal notes on what to do with each item? Where to offer it. Value

The total volume of optical stuff today thrown out or gathering dust because heirs don't know what to do with it probably would load a freight train For a trifling favor one amateur's widow recently tried to give your scribe a microscope worth several hundred dollars, while another amateur who had promised his copy of Ritchey's rare classic "On the Modern Reflecting Telescope" omitted to implement his promise with a memorandum for his heir before he died (earlier than he expected) and the book was burned up and so is your scribe Two examples of the crazy things that happen because heirs are left puzzled

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INDUSTRIAL DRAMA: Unforeseen — and highly satisfactory — have been some of the results gained by spraying molten metal on shafts which run in bearings For details see article starting on page 201

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50 Years Ago in . .

(Condensed from Issues of May, 1897)

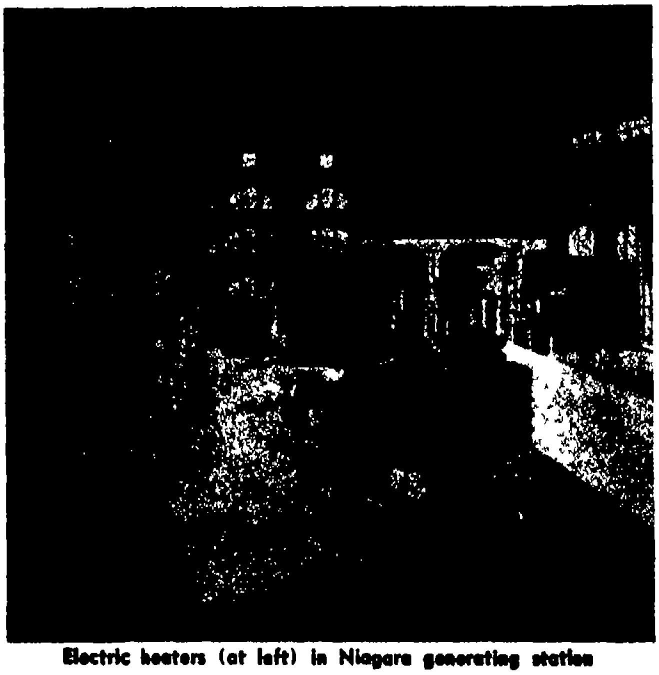
HIGH SPEED TELEGRAPHY — "By making use of the alternating current and special designs of receiver and transmitter, two well-known American specialists, Lieutenant G O Squier and Prof A. C Crehore, have succeeded in sending messages over a wire at the rate of twelve hundred words a minute, and they confidently assert that between three thousand and six thousand words a minute may be dispatched by the same system between points that are a thousand miles apart"

JAP LABOR PROBLEMS — "Like causes are producing like results in Japan, and the remarkable industrial development of the country is bringing in its train those very same industrial troubles which have harassed or are still perplexing the older civilizations of the West If recent labor troubles are an indication, it looks as though the apparent prosperity of Japan was not as healthy as it might be, and that it was based on the poverty and misery of the wage earners."

ALUMINUM COATING — "A new departure in the field of sheet metals has just been undertaken by a St. Louis, Mo., firm This firm has sent us samples of steel sheets coated with aluminum, which, it is claimed, are superior to and more durable than galvanized iron, tin plate or planished iron for many purposes for which those materials are now generally used. Moreover, they can, when desired, be polished to a luster equal to burnished silver or nickel"

SAFETY GOGGLES — "Injury to the eyes by dust, sparks, flying splinters, and stones is by no means rare, and only imperfectly prevented by the ordinary spectacles Dr Thomalla, of one of the Berlin accident wards, has devised a spectacle made of Schering's gelatoid, an elastic, transparent material, which can be hardened in amyl acetate If really broken by flying pieces, the mass does not splinter"

ELECTRICAL HEATING — "The Niagara Falls Power Company's big power station offers one of the most interesting studies on the subject of electrical heating to be found in the United States, if not in the world The heaters in the offices are on a secondary 100 volt circuit, and this circuit is fed through converters which reduce the voltage from 2,000 to 100. In the office portion of the power house there is about 175 horse power in heaters of the American pattern, but they are seldom all on at the same time. Of course, it depends entirely upon the weather conditions as to the amount of heat required to make the rooms comfortable In the dynamo room there are fifteen heaters, three circuits of five each, and each circuit takes up about 200 horse power However, it has never yet been found necessary to use all three circuits, two of them being found sufficient in the coldest weather By consulting the illustration in connection with this article the heaters will be seen on the left on the walls of the dynamo room, about 15 feet above the floor"



Electric heaters (at left) in Niagara generating station

RAILROAD TROUBLES — "By the dropping of the brake bar of a freight car of the new Third Rail branch of the N Y., N H & H R R., the switchboard at the Berlin, Connecticut, power houses was burned out, causing a loss of one thousand dollars, delaying probably for a week the opening of the Third Rail route between New Britain and Hartford"

SUBMARINE — "On Monday, May 17, there was launched at the Crescent Shipyard, Elizabethport, N J., an extremely interesting specimen of marine architecture, known as the Holland submarine boat. It embodies the results of some twenty years of experimental work on the part of the designer, who firmly believes that the submarine torpedo boat will prove to be the most deadly weapon of future naval warfare"

PAPER MACHINE — "At Rumford Falls, Me., the largest paper machine in the world is now in the course of construction by the Rumford Falls Paper Company It will produce paper 150 inches in width, which is said to be 15 inches wider than any American machine and 2 inches wider than any other machine in the world at the rate of 500 feet per minute, or, in a complete day's run of 24 hours, will turn out about 9,000,000 square feet, equivalent to 35 tons"

100 Years Ago in . .

(Condensed from Issues of May, 1847)

POWER — "The steam engine itself, improved as it is, and wonderful as have been the results produced by it, is capable of further improvements Its bulk and weight may be further diminished, both in the form and construction of the boiler as well as the engine itself, and thus in effect, its power may be increased, or it may be reserved to us to discover the means of producing, and rendering subservient to our purposes, some other power which shall surpass steam, or, perhaps, to substitute for it that all-powerful agent, electricity, which Jacobi has already attempted to apply to navigation"

BALLOON TIRES — "A number of cabs with newly invented wheels have just been put on the pave in London. Their novelty consists in the entire absence of springs. A hollow tube of India rubber about a foot in diameter, inflated with air, encircles each wheel in the manner of a tire, affording the greatest possible amount of cab comfort to the passenger"

ZINC CASTINGS — "Some of the French artisans have adopted the plan of casting statues and groups of figures, in zinc instead of bronze. By this means the cost of such models is very much reduced, while an equally good representation is produced."

TELEGRAPH WIRE — "The Directors of the New York and Buffalo Telegraphic Company, at their recent meeting in Utica, resolved to use in their operations an iron wire known as No 10, weighing about 250 pounds to the mile"

Long-distance Television is twenty years old

At the 1927 demonstration, Dr Herbert E Ives explained the television system developed in Bell Telephone Laboratories

APRIL 7 is a notable day in communication history, for on that day in 1927 was the first demonstration of television over long distances Large-scale images were flashed from Washington, D C, by wire and from Whippany, N J, by radio to a public demonstration in New York City "It was," said a newspaper, "as if a photograph had suddenly come to life and begun to smile, talk, nod its head and look this way and that"

That was the first of many public demonstrations, each to mark an advance in the television art In 1929 came color television, and in 1930 a two-way system between the headquarters buildings of A T & T and Bell Laboratories When the first coaxial cable was installed in 1937, television signals for 240-line pictures were transmitted between Philadelphia and New York and three years later 441-line signals were transmitted By May, 1941, successful experiments had been made on an 800-mile circuit

End of the war brought a heightened tempo of development Early in 1946 began the regular experimental use of coaxial cable for television between New York and Washington, and a few months later a microwave system for television transmission was demonstrated in California

Transmission facilities will keep pace as a great art advances to wide public usefulness

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Previews of the Industrial Horizon

By A. P. Peck

PUBLISHING COSTS VERSUS INCOME

Regardless of what some labor unions and "economists" may say about the necessity of maintaining low sales costs in the face of skyrocketing production costs, there comes a time when cold facts call for painful decisions One such decision has just been made. With the July, 1947 issue, the price of Scientific American will be increased to 50 cents a copy, five dollars a year

We looked at every angle, considered every possibility. But certain things could not be changed. In round numbers, our printing costs have increased 80 percent, paper is up 50 percent, and engraving has risen 40 percent, based on 1940 costs. Add similar increases in all other phases of business operation and it becomes obvious that something had to be done

One thing we refused to do· We would not sacrifice the editorial quality of Scientific American in order to cut costs. This must be maintained. So, since we cannot continue to absorb all of the cost increases and still stay in business, we reluctantly decided that the price of the magazine must be increased. We are sure that our readers will be in sympathy with this move, will understand that it was done only as a last resort, will bear with us until a downward readjustment can be made

See also important announcement on page 234.

MAN'S HUMANITY TO MAN

Application of the Golden Rule in industry and elsewhere, naïve though some may think it to be, is part and parcel of progress. More modern word for the Rule is "humanities," a subject that is becoming an ever more important facet of our complicated civilization.

Warning that the world must develop increased respect for the humanities, Dr Frank D. Fackenthal, acting president of Columbia University, gives this expanded and clarifying definition "The field of study is the natures of men, their psychologies, their explosiveness in this or that situation, their resistance to this or that movement even though it be for their advancement, their attraction to this or that idea though it may ultimately enslave them and destroy their freedom, their instinct for immediate individual welfare as against the long-term public good."

This indeed is a study worthy of as much attention, as much effort, as any research in the physical sciences Through it the physical sciences and all their potential possibilities can advance rapidly; without it, man and his industries will surely wither on the vine.

GAS TURBINES ADVANCE

Intriguing as are the simple mechanical features of the gas turbine, technicians in the field are still loath to become too glowing in its praise. Thus, Alan Howard, General Electric engineer, recently said· "While the gas turbine seems very promising, it is, nevertheless, still in the development stage."

Occasion for the statement was the announcement that tests are about to begin on a 4800-horsepower turbine unit—19 feet long and weighing between 2½ to 4 pounds per horsepower—that will burn Bunker "C" oil, with simultaneous work being directed toward burning powdered coal. Also on the General Electric horizon is a 5000-kilowatt machine for electric power stations, scheduled for tests within the next 12 months.

Further reports indicate that the powdered-coal-burning gas-turbine locomotive (Scientific American, August 1946) will be on the rails before 1947 becomes a mere memory

UNMINED COAL

Successful burning of coal underground, without the necessity of first mining it (Scientific American, December 1946), opens a number of fields for investigation Not the least of these is the use of the resulting gases in gas-turbine units, especially in areas where cooling water is scarce. Other possibilities stemming from this method of using unmined coal include manufacture of synthetic fuel from the gases, using the gases directly as fuel for industrial furnaces, and economical powering of high-temperature steam generating plants

An average of 35 to 50 percent of the available coal is left underground in present mining processes; it is reported that several more abandoned mines will be "fired" to further the experimental work on burning coal underground.

STRAWS IN THE WIND

Miniature vacuum tubes, already in use in hearing aids and pocket radio receivers, will aid aircraft radio as well, within the next few years it is predicted that a large transport plane will carry as many as 600 electron tubes which would weigh 225 pounds in present sizes but only 37 pounds in the miniature form. . . Soviet industry, eagerly gobbling up thousands of patent specifications to glean benefit from Yankee ingenuity, may point toward unseen riches lying at American industry's doorstep . The Gulf Coast, rich in petroleum, natural gas, salt, sulfur, lime, and so on, is making a strong bid for chemical industry's expansion southward; Monsanto, Du Pont, Shell, Dow, and others have already spent millions for plants in that area, more will follow. . . A number of manufacturers of equipment requiring small motors, stymied by far-distant delivery dates promised by established manufacturers of power units, are making the motors themselves, effectively breaking deadlocks which were preventing sorely needed products from reaching the market. . A bill (H. R. 2520) has been introduced in the House of Representatives which, if passed, will increase the patent-application filing and patent issue fees from the present $30 to $50 each, with similar increases all along the line.

27 JUN 1947

Scientific American
MAY • 1947

FIRELESS HEAT for the HOME

By HARLAND MANCHESTER

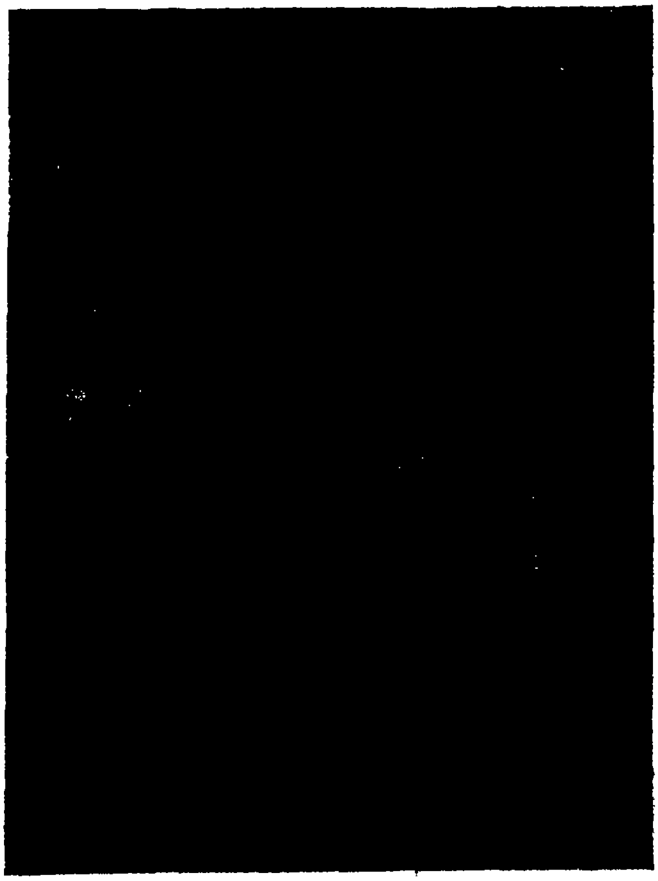
Heat Pumps, Electrically Operated "Refrigerators in Reverse," Can Provide Year-'Round Constant Temperatures — Heating in Winter and Cooling in Summer. One Automatic Unit Does the Entire Job. Cost, Convenience Considered, Compares Favorably with Established Fuel Burning Systems

During the winter just past, a few houses in central Indiana were heated by a revolutionary device which involves no dust, soot, stoking, fuel, furnace, flue, or fire. When summer comes, the device automatically shifts over to cooling. You set the thermostat once and forget about it.

This is the "heat pump," an ingenious idea which has been knocking around for 95 years and has at last been put to practical work by a few inventive Hoosiers. In principle, the heat pump is an electrical refrigerator running backward. Your kitchen refrigerator cools the food by pumping the heat out of the box and throwing it away. Put your hand in back of it and you can feel the hot air coming out. If the cycle were reversed the refrigerant gas would collect heat from the outside air and pump it into the food compartment. That is what the heat pump does. Even in the dead of winter, there is heat in the outside air, in the ground and in the water in wells and streams. The Indiana house-warmers collect this heat and use it to produce hot air which is circulated through registers.

A few dozen of these systems have been in use for several years, but they were too expensive to operate in any but mild climates. Now two rival Indiana firms, one at Indianapolis and the other at Muncie, are pioneering in the manufacture of new types of heat pumps which are equally suitable for Florida or Minnesota.

The Indianapolis heat pump, the Terra Temp, originated in the restless mind of a 35-year-old cellar inventor named Robert C. Webber, a North Carolina native who for many years worked for the local power and light company. Mr. Webber has long been a deep-freeze enthusiast, and builds his own freezers. He has four of them. One day four years ago he ran one of his boxes down to 95 below zero to see what would happen. He put his hand on the outlet pipe and almost burned it. That set him to thinking on a new tack. Here was a lot of heat being thrown away. So he ran the outlets from his freezers through a boiler, with the result that his family had more hot water than they could possibly use. He was still wasting heat, and wondered what to do with it. His seven-room house was warmed



Interior and exterior views of a Marvair heat pump installed in a building of Pennsylvania Power Company

• LOOKING AHEAD •

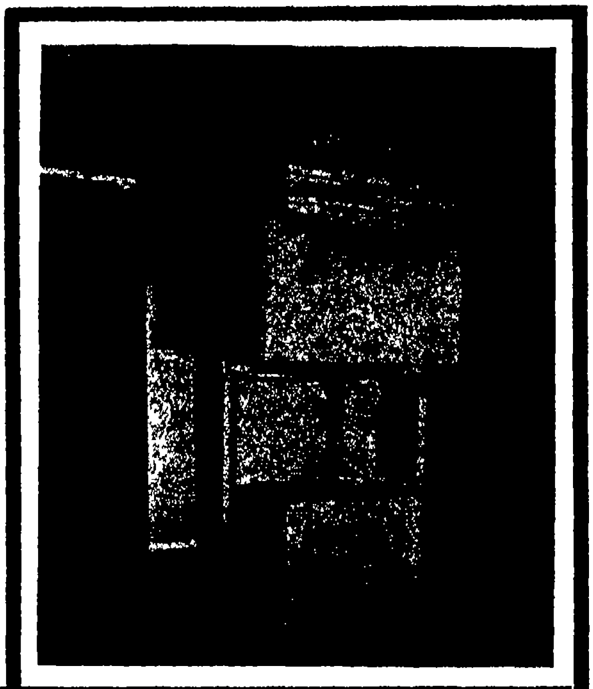
New homes without chimneys . . . Competition of electrical heating with coal, gas, and oil . . . First wide-spread use of heat pumps in areas where current cost is low . . . Increasing desire for comfort-cooling systems in homes . . . Expanding markets for utility companies

by hot air from a coal furnace He decided to use the surplus heat from his freezers to save coal, so he piped some of the hot water from his boiler through a coil beneath one of the floor registers, and installed a small fan to drive air past the hot coil

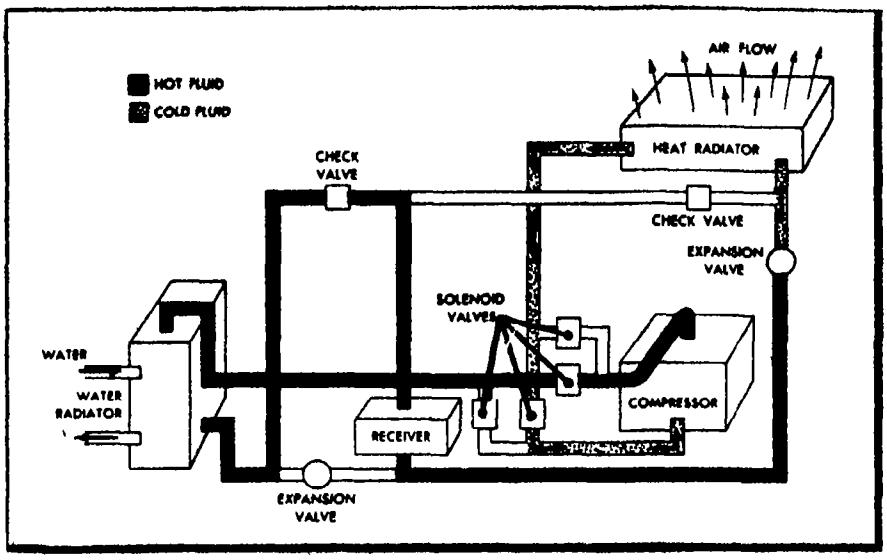
The results were so encouraging that Mr Webber decided to build a full-size heat pump to warm the whole house That meant a great deal of figuring, shopping for scarce materials wherever he could find them, and working evenings and week-ends for the better part of three years

HEAT FROM THE GROUND—Lord Kelvin discovered the heat pump in 1852, and in recent years a number of window-type air-conditioning units have been installed which can be reversed in cool weather to extract heat from the outside air This is expensive heating, the colder the day, the more thinly the heat is dispersed in the air and the more power it takes to collect it But Webber hit upon a new idea Why not pump heat from the ground below the frost line, where the temperature doesn't vary more than 20 degrees or so throughout the year? So he dug a ditch in his back yard and buried 400 feet of ¾-inch copper tubing Freon gas circulates through this tubing and picks up the ground heat. When it reaches the heat pump in his cellar, the gas is compressed to a liquid which then goes to a condenser Here it gives off its heat, and the now expanded gas goes back through the ground coil to pick up another load Air is driven by a fan through the hot coil in the cellar (the condenser) and sent through ordinary ducts to registers in the rooms, while ducts near the floor bring back cool air for reheating

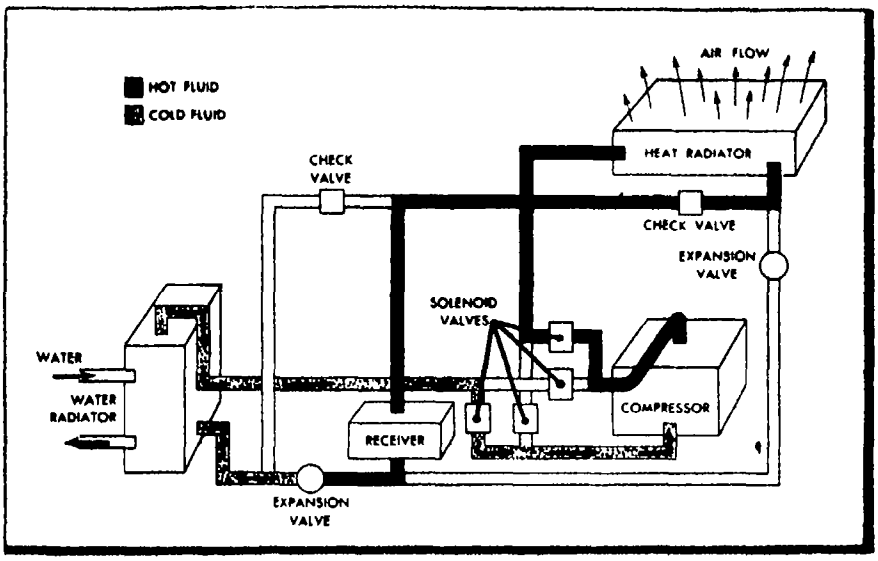
Webber has been heating his house this way for three winters, and everyone is happy Last winter he gleefully sold his coal furnace Parts and materials for his heat pump cost him $524. For the first winter, from October 1 through May, the cost of electricity to run the pump (at two cents a kilowatt-hour) was $124 This is about $16 more than he used to pay for coal, and he also points out that a new



Right Side view of a Terra Temp heat pump in the cellar of Webber's home, showing part of the duct system for distributing warm or cooled air as required by outside temperatures. Below Front view of the same unit, showing main motor at the right The entire installation is placed out of the way under the cellar stairs



Simplified diagrams of the heating and cooling cycles of the Marvair heat-pump system Water from the deep well, not shown, circulates through the water radiator at the left in each diagram Left Cooling cycle when room temperature is above thermostat setting Below The cycle when thermostat calls for heat



house-insulation job favors his heat pump But he says it's a cheap price to pay for not having to shovel coal and haul ashes And his cellar looks as clean as a surgeon's glove

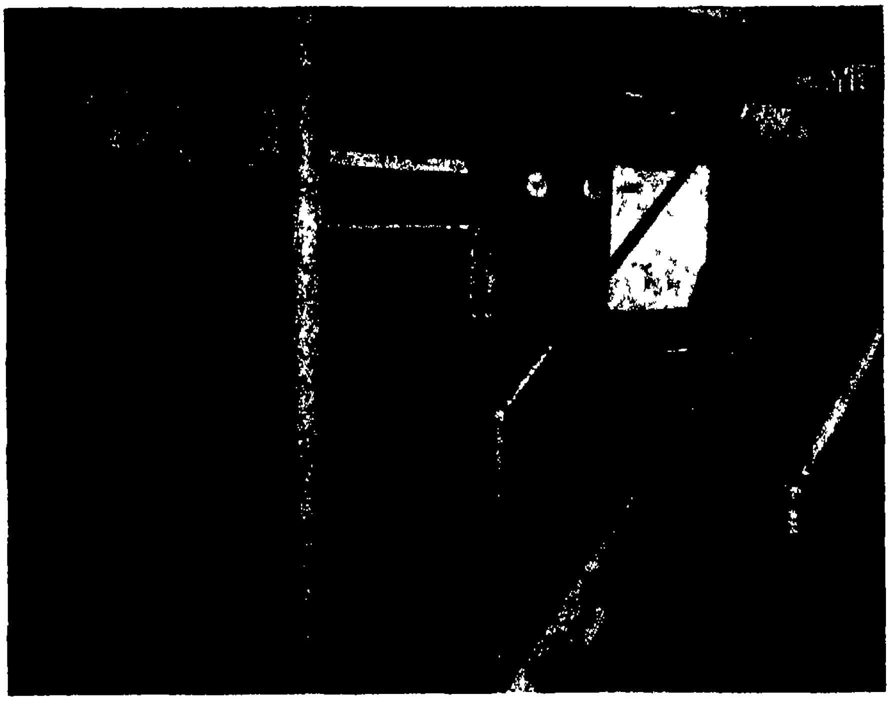
PLUS AIR COOLING—At no added cost, he has an air-conditioning plant for the blistering Indiana heat waves—a luxury enjoyed in very few homes When the temperature goes above a certain point, the machine reverses itself, pumping heat from the house and dispersing it in the relatively cool ground. The cooling job, he reports, uses somewhat less juice than does winter heating

Mr Webber built his heat pump for his own use with no definite plan for exploiting it commercially, but he soon found that the world was beating a path to his door Now the Terra Temp Company of Indianapolis has been organized to take over his patents and manufacture the novel heating plant on a mass-production basis Further research is under way and more efficient models have been built One resembles a large streamlined refrigerator which, in a cellarless house, would look attractive in the kitchen or a utility room The Armour Research Foundation of the Illinois Institute of Technology has constructed a laboratory model and is securing data for the guidance of the manufacturers and of building contractors in various climates Norman Kevers, one of Terra Temp's founders, estimates that the heating system, completely installed, should sell for less than $1000

This is one man's heat pump There are others Some 60 miles from Mr Webber's doorstep, in a veterans' housing development in the University Heights section of Muncie, stands a spic-and-span new four-room bungalow with no chimney When William A Spurgeon and his bride moved in last October, they set the thermostat at 72 and left the rest to the Marvair heat pump in the cellar If the house cools down to 71, the pump goes on, and 30 seconds later hot air comes through the registers If the thermometer goes above 73, the device reverses itself and blows in cool air until the temperature drops to the correct level When June comes, with hot days and chilly nights, the Spurgeons will still do nothing about it Come heat or cold, the robot in the cellar will accurately provide the desired indoor temperature Other installations are being made

220-FOOT WELL — The Marvair heat pump is the product of Muncie Gear Works, Inc, an old, experienced firm which also manufactures coal stokers and outboard motors Instead of taking heat from the ground, Marvair pumps it from well water Back of the Spurgeon house is a 220-foot well. Through a continuous loop of pipe running from the bottom of the well to the heat pump in the cellar, 15 gallons of water constantly circulate This water picks up the heat in the well water (which draws it from the surrounding ground), carries it to the cellar, and uses it to heat freon gas in a coil through which it passes. The gas is compressed to a liquid, which makes it much hotter, then it expends its heat on a stream of air which is driven by a fan through conduits into the rooms Cold air is returned through other conduits for reheating Thus the heat units in the well water are collected and moved to the living-room by means of three intermeshing cycles of water, gas, and air, and the whole thing is driven by electric power from the utility line

The reader may protest that it is prohibitively expensive in cold climates to heat a house by electricity It is, if you are using ordinary electrical resistance heaters The secret of the heat pump is its superior efficiency Theoretically, it will convert the electric power equivalent of one resistance-heat unit into six or seven heat units in your house So far, in actual practice, the yield is between three and four, but engineering projects now under way may bring even better results It is the first method ever devised which shows practical promise of obtaining household heat from



Marvair heat pump in the Spurgeon home in Muncie, Indiana

the cleanest, safest, and least bothersome source—electricity

Aside from heating in winter and cooling in summer, this device can heat water far more cheaply than the electrical water heaters now in use A large utility company, aware that resistance heating cannot meet the competition of gas-fired water-heaters, has sent specifications to manufacturers for a heat pump for this purpose As Mr Webber proved in his cellar, refrigerators and deep-freeze boxes can be coupled with a heat pump It would be easy to add a bathroom tap for ice-water Today we buy one expensive device to throw away unwanted heat and another one to get rid of unwanted cold The heat pump can be made to swap the two, with an important saving in equipment and power It will perform all household heating and cooling jobs except cooking

PRODUCTION PLANS—Both of the Indiana firms have ambitious production plans They don't expect 30,000,000 American householders to junk their furnaces overnight and put in heat pumps, but as more of the effortless indoor heating and cooling systems are seen throughout the country, they are confident that the demand will keep them busy While Terra Temp is in the process of getting under way, the Muncie firm has converted an entire plant to producing its Marvair pump, and has 3500 firm orders to be filled before July Muncie originally planned to build 10,000 units this year, but has had to cut this estimate in half because of material shortages

Heat pumps of various types are being installed in all climates In mild Los Angeles, a number of pumps are in use which extract heat from the outside air, and the Drayer-Hanson firm of that city plans to build 5000 this year, suitable for use in the Southern belt of the United States Three Marvair heat pumps using deep wells are being installed in houses in Binghamton, New York, and there are orders from other cold-winter places like Montreal and Milwaukee

Utility companies throughout the country are showing a lively interest in the heat pump Its use even in a small percentage of homes would add tremendously to their market for power

Many firms have installed it in their office buildings, among them the Ohio Power Company, which uses it for heating and cooling buildings in Portsmouth and Coshocton, Ohio However, its first big boom will probably be in the TVA area, where power sells for as low as four mills per kilowatt-hour C B Osborne of the Chattanooga Electric Power Board heats and cools his house with a Marvair unit, and several others, of both the ground and water type, are being installed in other Chattanooga houses An individual well 200 feet deep is expensive business Existing shallow wells or cisterns are not suitable because there is not enough adjacent ground area to supply the needed amount of heat S R Finley, general superintendent of the Board, suggests that the cost of deep wells can be eliminated by tapping the water of the Tennessee River to bring the new heating and cooling system to all of downtown Chattanooga Both the first cost and the cost of operation are at present somewhat higher than oil and coal heating systems, but compared with the cost of separate heating and air-conditioning plants, it's a bargain As Marvin Smith, Marvair executive, puts it "You buy air conditioning and get your heating system thrown in free" And it doesn't take water from the ground, which disposes of one air conditioning problem in parts of the country where the water table is dangerously low.

OPERATING COSTS — The heat pump's further progress will depend largely upon the cost of electric power and the cost of household fuels in various parts of the country One expert estimates that with electricity at one cent per kilowatt-hour and coal at $10 a ton, the heat pump can match the cost of conventional winter heating, to say nothing of the advantage of summer comfort At present there are few places where power can be bought at that price, but with wide adoption it is probable that power companies would put a separate meter on the pump and establish a special rate They make this arrangement now for household electric water heaters, which operate during the morning hours when the power load is light By adding an insulated hot-water storage tank, the heat pump might also help to smooth out the power demand

The Muncie firm plans to sell its Marvair unit for about $1700, all installed and ready to set the thermostat for whatever year-'round indoor temperature you wish This includes the cost of the well, which in actual jobs has varied from $300 to $800 If this type of heat pump wins out, a rotary core driver can dig wells much more cheaply And if Mr Webber's ground-coil system gets the breaks, digging costs will be still less On the other side of the ledger, houses will not need chimneys, expensive items which now run up a construction bill $300 to $500

All this adds up to the conclusion that the new heating system has its foot firmly in the door In the early '20's, only the well-to-do owned mechanical refrigerators Old-fashioned ice-boxes were much cheaper, but convenience won out, and the iceman cometh no more Liberation from the coal shovel, from dust, smoke, and summer heat would be a priceless boon Don't expect delivery next week, but we may be headed for something like a domestic millenium

Metallizing TAKES OVER

Struggling to Rise from the Status of a Stunt Process to That of a Respected Tool of Industry, Sprayed Metal, With Its Unusual Metallurgical Structure, Offers Solution to Difficult Production Problems

By EDWIN LAIRD CADY

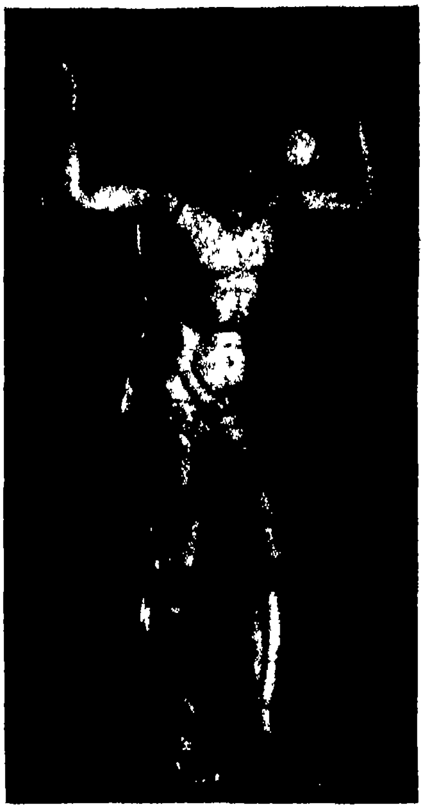
SOME 30 years ago one of the developers of metallizing sprayed molten metal on the head of a kitchen match. The match did not ignite. He was to make this demonstration again and again. He was to be sorry he ever had done it the first time. It was just a stunt. And metallizing (molten metal spraying) has spent its entire growth-period fighting off with one hand the attempts to use it as a futile stunt process, and working with the other to build its place as a solid technique of industry.

Much of the demand to do stunts has come from the fact that metallizing is so completely unrelated to any other industrial process. Briefly, this process consists of feeding a metal wire or rod into an aceytlene flame, picking up the molten metal in a compressed air blast and blowing it onto the object which is to be coated.

This might sound a lot like paint spraying. But sprayed paint is much like brushed paint. And sprayed metal is like nothing else made of metal.

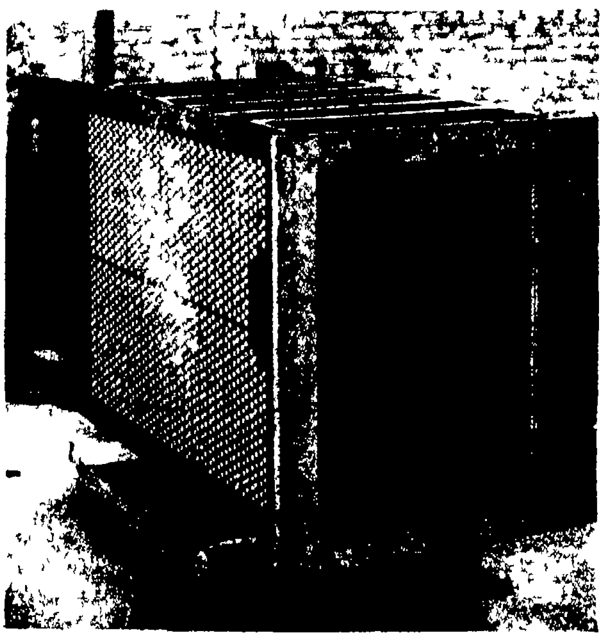
Seen through a microscope, sprayed metal does not resemble the granular structure of cast metal or the somewhat fibrous structure of wrought alloys. On the contrary, the sprayed metal looks like millions of tiny apple pies squashed down upon each other. Many a metallurgist looking at it for the first time has said "there ain't no such metal. There can't be." Many another has said "it disobeys all of the laws of metallurgy. It cannot be any good."

The practical production man who finds a machine or process going wrong is apt to say "I've got to get the bugs out of it." For debugging he turns to an odd process—the odder the better. Metallizing with its reputation for odd stunts and odd metallurgical structures is highly inviting to him. And in plenty of cases it works.



Courtesy Eastern Metallizing Company

The thorough restoration of this dry rotted antique wooden statue is an excellent example of metallizing wood



Courtesy Metallizing Company of America

Metallizing insures longer and more efficient operation of this heat exchanger structure

HEAT RESISTING—One example is that of heat exchanger tubes. These often are made of copper because their function is to conduct heat and copper is second only to silver in its heat-conducting ability. But they frequently have to take the waste heat out of exhaust gases at temperatures as high as 2000 degrees, Fahrenheit. At temperatures quite a bit lower than this, copper is likely to disintegrate rapidly enough so the costs of tube replacements are high.

To solve this one metallizing had to work out a process. An alloy of aluminum and copper is much slower to disintegrate. Metallizing could put a thick coating of aluminum on the copper but could not cause the two metals to fuse together into an alloy. The aluminum therefore was sprayed onto the tubes, then the tubes were placed in a furnace and held at a temperature of about 1600 degrees, Fahrenheit, for one hour. This caused the forming of an alloyed coating which will protect the copper tubes at temperatures up to 2100 degrees, Fahrenheit.

And so, in taking the bugs out of copper heat-exchanger tubing met-

Courtesy Eastern Metallizing Company

Metallizing is an economical method of applying a corrosion resistant coat to frozen food equipment

• LOOKING AHEAD •

New techniques to lower both initial and maintenance costs of bearings and shafts More effective, less expensive protective metal coatings for objects of any size Low pressure dies, molds, and related items fabricated swiftly, simply, and at a new low cost

allizing worked out a solid process and found a consistent market for itself This application no longer is a stunt, but is an accepted technique of industry And metallizing likes to develop these steady "bread and butter" markets

Prolonging the lives of pots used for carburizing of steel products is another example For a great many years the steel treater had two choices He could use common cast iron pots which were low in first cost, but which failed rapidly under the furnace heat on their exteriors and the weights of metals and pressures of gases against their interiors Or he could use costly alloy pots such as those made of Nichrome

There were many attempts to fill in between these extremes—to make carburizing pots of middle endurances at middle prices Pots were made of special cast irons, cast steels, molybdenum bearing alloys, and given surface carbon treatments

All of these worked for some applications, but metallizing was able to go much further Common cast iron pots, or any of the special steel and alloy ones, can be metallized with aluminum, Nichrome, stainless steels, or almost any alloy which is known to impart heat-endurance properties Pots of the same materials which had failed after only eight hours of service lasted more than 100 hours after being inexpensively metallized.

ON SHAFTS—Metallizing of shaft surfaces which are to operate in journal bearings (plain hole bearings or plain sleeve bearings) is having little-understood effects which may completely change some machine design practices

The shaft surface usually is much more costly to renew or replace than is the sleeve surface in such a bearing Therefore, the bearings have commonly been so designed that the sleeves or the plain holes would wear first and would leave the shafts comparatively unworn But when the shaft surfaces finally showed bad amounts of wear, the shafts had to be replaced or their surfaces renewed

Many shafts were so large or of such complex contours that replacing them was costly Metallizing was tried, largely as a "last hope" process, for renewing these It was tried in increasing numbers of instances when the war made replacement parts impossible to obtain

The metallizing often gave results which were astounding Nobody as yet fully understands them, although their explanations may lie in certain theories of bearings

When a bearing is operating improperly because of wear or overload, several things happen in complex combinations First, any lubricant which exists in the pores of the bearing metals is drawn out and begins to function. Second, the shaft and sleeve alternately seize each other and then let go, thus setting up vibrations; overloaded bearings make noises, which range from squeals to groans Third, the bearing temperature is raised by the increased friction Fourth, as the temperature increases, the metals expand, reducing the clearance within which the lubricant can operate They seize more and more completely, and finally either seize altogether and "freeze," or else fracture or melt one of the bearing members

Sprayed molten metal helps to meet all these enemies of the bearing Its "pie upon pie" metallurgical structure is an excellent reservoir for small supplies of lubricant, and can help the lubricant to keep the trouble from becoming serious This same structure is one of the best dampeners of vibrations and can reduce the "bound and rebound" effects which would otherwise cause the bearing to seize more rapidly As the temperatures builds up and the shaft and journal expand, the tiny voids which exist within the sprayed metal become areas into which the expansion can go, rather than all of the expansion being imposed between the bearing surfaces

The results of this have been proved again and again in the operations of machines Many a shaft, "temporarily repaired" by metallizing, has lasted much longer than it did when brand new And scientific measurement has confirmed these experiences

BEARINGS TESTED—A recognized scientific method for determining bearing qualities is to mount a shaft in a standard bearing sleeve which is so split that its halves can be forced toward each other The shaft is revolved at a standard speed, and a standardized lubricant is fed in measured standard amounts to the bearing The bearing halves are then forced toward each other with standard time increments of pressure. The result is that under completely standard conditions the bearing is subjected to gradually increasing pressure At some point the pressure will become great enough so the bearing will seize or otherwise fail Since the rate of pressure increase is known, the time-period for which the bearing endures this test becomes a direct measure of the bearing endurance

A low-carbon steel shaft had its surface finished for bearing purposes in the usual way A second shaft was metallized with the same low-carbon steel, then was machined to bearing surface smoothness in such fashion that the bearing areas of the two shafts would be alike in diameters Both shafts were submitted to this test, the testing being done in an independent and unbiased scientific laboratory The plain carbon shaft endured eight hours, the metallized shaft 20 hours

With results like these in his hands, many a machine designer is changing his ideas about journal bearings Shafts are being metallized on original production lines, are entrusted with much heavier bearing pressures and higher speeds in their machines, and are re-metallized as a standard maintenance operation if they wear Some shafts are metallized with very hard materials such as Stellite, others with ordinary carbon steel, or with corrosion resistant alloys if the bearing area is subjected to corrosive materials in service

Courtesy Eastern Metallizing Company
Low-pressure die made by metallizing

CANNOT BE HAMMERED — Not solved by metallizing, as yet, are the problems of anti-friction bearing seats A sprayed metal coating is tenacious, it can be almost impossible to remove without also removing some of the base metal But it is too brittle to resist direct hammering or peening action Gear teeth, for example, should be metallized only if they operate at extremely slow speeds and in the presence of abrasive materials which wear them rapidly

The making of dies, molds, and pans of intricate contours is a rapidly advancing field for metallizing The master models or patterns for precision investment casting can benefit from this technique

In one instance, a contoured mold which did not have to endure extreme pressure or abrasion was wanted The estimated cost of machining it from the solid was $3000 Metal spraying made it for $400

The production sequence for this was 1 Make a wooden pattern of the mold 2 Surround this with a steel frame, the frame being a weldment 3 Spray consecutive layers of zinc to the mold and the frame, following the contours of the wood, until the zinc was one-half inch thick 4 Remove the wood pattern, leaving the frame as a protection and stiffener for the mold

Metal-sprayed zinc has unusual ability to protect metal surfaces, a coating of it 003 inch thick being said to have more than four times the salt spray test endurance of a normal 0025 inch thick electro-deposited coating And the metal-sprayed coating can be built up to any desired thickness whereas the electro-deposited (galvanized) coating is limited Racks for frozen foods and other foods handling equipment are now metal-sprayed as a standard protective procedure Whole rooms in packing houses have been sprayed with tons of protecting metals

In one field after another, metallizing is finding ways to solve problems In so doing it has become a settled, even a sedate industry But it never is likely to become too sedate There is never a day during which some metallizing sales engineer is not asked to show how he can spray molten metal onto the head of a match However, when metallizing calls at the factory door it still is likely to be taken by the hand and led to the odd problem—the problem that "has bugs in it"

* * *

ASCENT BY ROCKET

Envisioned From Passenger's Viewpoint

Many a man has wondered what it would feel like to go 100 miles straight up in a rocket Dozens have volunteered to find out Nobody as yet has made a successful flight The business of getting back to the ground would be too hazardous, the chances of making it too slight. But scientists have sent up instruments, also a movie camera, and have put together the story from the film and the records

The passenger would climb a ladder, enter a chamber high in the nose of the rocket. The door would be closed tightly and securely fastened The cabin would have to be pressurized

He would strap himself into a padded seat, probably make a wise crack or so about padded cells All around him would be windows, before him a bank of instruments

For about three seconds he would see the glow of a bright orange flame as the preliminary jet let go Then the rocket would begin to move

The take-off would be slow, no more rapid than the movement of a heavily loaded truck leaving its loading platform But all around would be a roar like a million blow torches all going at once

Then he would be pressed down heavily in his seat The rocket would be picking up speed, accelerating The human body can stand a peak acceleration of five Gs (five times gravity) The rocket would not reach that But in 50 seconds it would reach three or four Gs, and only a man in good condition could take it

In 65 seconds all of the fuel would be gone but the rocket still would be going In three minutes he would be at the top The visible ground area would have been widening and flattening below him He might be able to see objects 900 miles away The rocket would be rolling and tumbling by now When his windows were aimed at the sky he might see only dense blackness and he might see the stars at the brightest any man ever has seen them The rocket-borne camera has seen only blackness, but balloon ascent theory says that the sky would be the clearest of night skies

The rocket would start back down He would not know when this happened unless his instruments told him It still would be rolling very slowly The tail surfaces wou'd then take hold and the nose go down He would tighten the straps which kept him from diving out of his seat All the objects that had looked smaller and smaller as he went up, now would look larger and larger

At a safe height an automatic device would work It might eject him from the rocket, and it might eject his entire cabin Scientists have not determined just how to work that

One parachute would open, catch the air, explode from the force A second would open, be torn to ribbons The third or fourth might hold

Then he would be on the ground And he would promptly get a ghost writer and write a book —*Edwin Laird Cady*

OXYGEN by the TON

Capable of Turning Out Unprecedented Volumes of Oxygen Daily, Projected Plants Will Make Available to All Industry Vast Quantities of That Gas, of Adequate Purity, at a Fraction of Present Cost

By D H KILLEFFER
Chemical Engineer

• LOOKING AHEAD •

Greatly increased efficiency of many oxidation processes to result from the reduction or elimination of diluting gases Processes heretofore considered impractical, due to expense or difficulty in obtaining proper heating, to be brought into the pay-off bracket Oxygen finding more and more applications throughout all industry, with oxygen taps becoming nearly as prevalent as water and compressed-air sources

OXYGEN, most plentiful of all the chemical elements, has come out of World War II ready to bulge into new and larger places in our industrial economy A revolution threatens, and not a minor one Although nearly half of our world and all that is in it (actually 46 46 percent) is oxygen, we are only now becoming seriously discontented with production of this extremely useful gas One example of the need for accelerated oxygen production is seen in a projected plant that will convert natural gas into motor fuel and Diesel oil This plant alone will consume oxygen faster than our present total production Futhermore, this plant will probably be the first of a series of such plants All this is much more than a simple expansion of demand it is a magnification, and it makes oxygen appear to be a quite new and revolutionary thing, certainly worth looking into

This oxygen renascence grows out of forces that have operated over a long period They have been focussed by developments of the recent war period, and given new and vigorous life The basic facts are quite simple The air over each five square feet of the earth's surface contains something over a ton of oxygen, but this is so thoroughly mixed with nitrogen and other gases that it is expensive to separate The second important fact is that vast numbers of chemical reactions involving oxygen can be better carried out by using oxygen without the serious dilution of the four volumes of nitrogen which normally accompany it The most important reason that nothing has been done about this in the past is that most such reactions really go on quite well with ordinary air—so well that the possible gain by using oxygen instead has never seemed particularly attractive But the tremendous demands for production to supply the machinery of war, and the serious depletion of some of our high-grade natural resources to meet them, forced attention to every possible means of raising output This came at a time when it was quite impossible to get more output by the usual simple expedient of building more plants Something had to be done to get more out of existing equipment That meant, among other things, to avoid diluting the oxygen which is vital, with inactive nitrogen, which simply takes up space In those words the idea sounds very simple, and indeed it is, but scarcely that simple First, you must get your oxygen

GETTING THE OXYGEN — That problem has heretofore assumed very much the aspect of the old question of the prior arrival of the hen or the egg. Cheap oxygen would undoubtedly promote demand, and large scale demand would certainly lead to materially lower prices War stringencies forced the decision, and both appear to be arriving together Heretofore, the purchasers of oxygen have been well pleased with a price of 55 cents per hundred cubic feet, which is equivalent to about $125 per ton That is for 99 5 percent or better oxygen But most tremendous scale industrial uses can be quite well satisfied with a somewhat lower purity gas if it can be had at a lower price

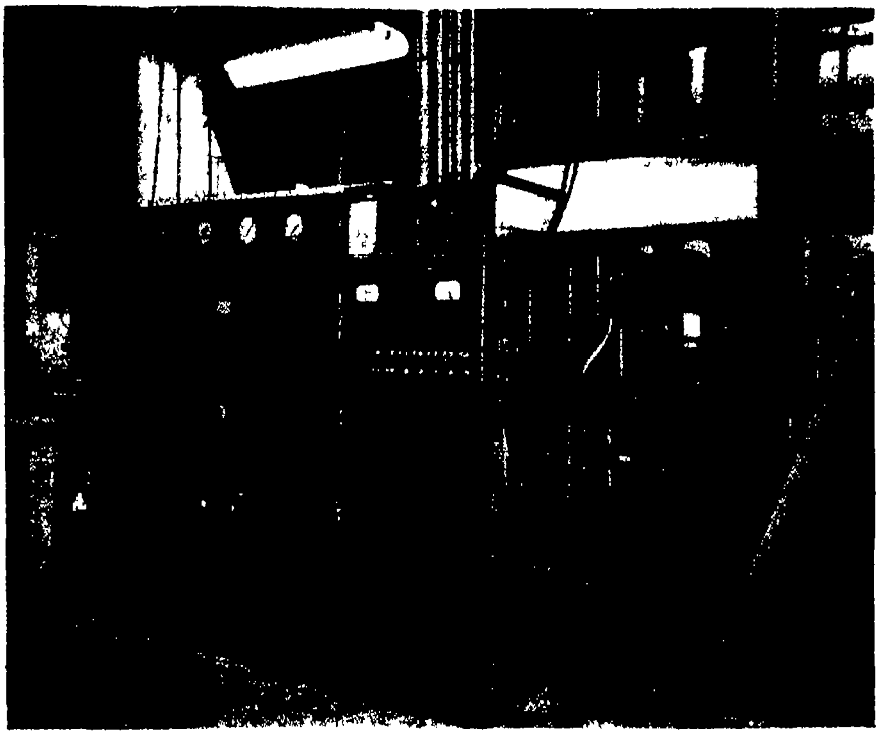
Obviously, the advantage to be had from oxygen comes from enriching the air used in most processes, and in only a few is there any particular necessity to go to the maximum possible purity Thus the concentration of oxygen can be established for each enterprise at the point providing the greatest overall economy, considering cost of concentrating and advantage gained New and improved methods of recovering 95 to 97 percent oxygen from air can be operated at a cost of $2 75 per ton of the gas in a plant with an output of 1000 tons per day and up to $5 21 per ton if the plant is designed for only 120 tons per day Such figures are entirely new to the art Plants of these magnitudes are still new to American industry, and costs as low as those mentioned are quite out of line with past experience Large forces are involved in such an expansion and large results can be expected from it

In Scientific American for September, 1946, page 101, some of the implications of enlarged oxygen supplies for the mechanical industries were examined These were found to be developments and growth of traditional uses, enlargements principally of present demands While the present mechanical uses may change in some respects, their relative magnitudes are unlikely to be completely upset The steel industry consumes about 40 percent of present oxygen output in its operations, particularly scarfing (29 5 percent) Another 25 percent goes for steel fabricating and industrial maintenance uses about 8 percent more The remainder is divided into many small uses The sum total is some 40 to 50 thousand tons per month

Contrast to that the consumption planned for the *single* chemical plant already mentioned of some 2000 tons of 95 to 97 percent oxygen per day 60 000 tons per month

LIQUID FUEL FROM GAS—Conversion of natural gas, which is still abundant in this country is looked upon as the most practical way to meet the diminution of our oil reserves under the continued drain of our use of liquid fuels The several possible reactions available to perform this transformation of gas to liquid fuels are based on an initial conversion of the hydrocarbon of the natural gas (largely methane) to carbon monoxide and hydrogen by reaction with oxygen, subjecting the mixed gases to further reaction gives heavier hydrocarbons together with more or less minor amounts of oxygen-bearing compounds that have value in other ways than as fuel

For efficient operation of the initial reaction, as well as the subsequent conversion of its products the mixture of active gases should be as free as possible from dilution by nitrogen These reactions are to be employed on a huge scale first in the Texas natural gas field to produce some 5800 barrels of gasoline and 1200 barrels of Diesel fuel daily In addition, substantial but reasonably controllable quantities of chemical compounds containing oxygen will be available as by-products from the same operation Estimates place the total output of alcohols, aldehydes, ketones, and organic acids from this single plant in the neighborhood of 160 million pounds per year without affecting fuel production



Photographs courtesy M W Kellogg Company

The control panel of an existing low pressure oxygen plant capable of producing a volume equivalent to 21 tons per day (above) The reversing exchanger tubes of a high pressure oxygen plant with a similar rate of production (left)

INCREASES OUTPUT — As has already been noted, oxygen is preferable to air in chemical processes because it avoids diluting the reacting mixture with nitrogen, thus increasing the output of given equipment or allowing its size to be reduced for the same output A second significant advantage of oxygen is that many reactions can proceed when oxygen is used that become sluggish or stall entirely with air Reporting on the subject of "tonnage oxygen," Downs and Rushton suggest six fields of chemical application that will be affected by the use of cheap oxygen in huge quantities In *Chemical Engineering Progress*, they list these immediate possibilities

"Oxygen, or oxygen-enriched air, undoubtedly will be employed on a very large scale for improving processes or products or in the manufacture of new products in the process industries Potential examples are

"1 For the production of gas from coal by continuous complete gasification for use as city gas of current or increased thermal content

"2 For the production of gas with a composition suitable for synthesizing hydrocarbons, oxygenated products, and ammonia from coal and natural gas

"3 For the oxidation of ammonia (to oxides of nitrogen and ultimately nitric acid) and sulfur dioxide (to trioxide and ultimately sulfuric acid), and for partial oxidation of organic compounds to derivatives

"4 For roasting and burning sulfide ores, pyrites, and other sulfur-containing compounds

"5 For smelting iron ores and for refining iron in Bessemer converters and open hearths

"6 For combustion of fuels where unusually high temperatures are advantageous, as in calcining, and perhaps even for the direct combination of nitrogen and oxygen

"It is possible that cheap oxygen may even revive the Deacon process (recovering chlorine from hydrochloric acid by air oxidation) and that hydrogen peroxide may be found more economical to make from hydrogen and oxygen than by other indirect methods"

HIGHER HEATING VALUE—Clearly, the complete gasification of coal is simplified and made practical if the partial combustion of the coke to carbon monoxide a reaction essential to supply heat for the simultaneous water-gas reaction, can be carried out without diluting the product gas unnecessarily with nitrogen introduced with air Replacing air by oxygen, or even enriching the air used, in this operation greatly improves the reaction taking place and renders it more effectively controlled At the same time it obviates, or substantially reduces the percentage of, diluting nitrogen in the product gas and thus correspondingly raises its heating value

The gas mixtures used in synthesis of liquid fuels and derivatives of hydrocarbons consist principally of carbon monoxide and hydrogen with possibly some hydrocarbon if natural gas has been the raw material These mixtures require the simultaneous operation of the water-gas reaction between steam and carbon or hydrocarbon, and some direct oxidation to supply the heat needed to keep the water-gas reaction going The situation is much the same as for complete gasification of coal except that here the efficiency of the subsequent synthetic reactions depends closely on the concentrations of the constituents of the gas mixture and the absence from it of any diluent If ammonia is to be made, the mixed gas to be prepared as raw material consists of three volumes of hydrogen and one volume of nitrogen, obtained from water gas and producer gas by conversion of the carbon monoxide content to carbon dioxide which can be washed out Here again the close control of the basic reactions, possible through use of oxygen alone or as enrichment of air, adds significantly to the overall efficiency of the operation

IN ACIDS—Oxidation of ammonia for the production of nitric acid is made considerably more efficient if the product of oxidation is not diluted with nitrogen This is advantageous in raising the capacity of the equipment by an amount corresponding to the nitrogen omitted and it further improves the efficiency of absorption of the nitrogen oxides and the capacity of the absorber

Sulfuric acid production also benefits substantially by the same concentrating process When air is used in the ordinary manner, the maximum concentration of sulfur dioxide possible in the raw gas is 14 percent to leave 7 percent oxygen in the mixture to convert sulfur dioxide to trioxide, which combines with water to form sulfuric acid Although this is a theoretically possible mixture, practice is to use about half that concentration of sulfur dioxide (7 5 percent) This percentage is arrived at as most practical because the mixture in any case contains 79 percent inert nitrogen Any enrichment of the air supply by introducing oxygen gives a tremendous increase in output of both sulfur burners and sulfuric acid plants, whether contact or chamber plants

This does not consider the possibility opened by oxygen enrichment of burning lower grade pyrites than is feasible with air Not only pyrites but numerous other sulfur-bearing ores support combustion in practicable furnaces only when of a relatively high grade For this reason many large ore bodies are not practical to smelt by the usual processes but require additional heat to be supplied by a supplementary fuel fire to maintain their combustion Thus, the availability of oxygen for enrichment of smelting air would lower the cost of treating low-grade sulfide ores (including many now uneconomical to smelt) and would at the same time raise the value of the sulfur dioxide by-product of the smelting process

METALS PRODUCTION-Enhanced output and efficiency of iron- and steel-producing equipment would naturally follow enrichment of their air supplies with oxygen Here again the benefit would be achieved by raising temperatures through removal of diluent nitrogen, by increasing the speed of reaction between more concentrated reactants, by reducing the quantity of exit gases and hence their heat-carrying capacity, and by this means, raising the temperature and reaction rate in the active zone Not only is output increased in this way, but a number of alloys such as 50 to 60 percent ferrochrome can be made in blast furnaces that now require electric furnaces

High temperature operations of various kinds are improved by the possibility of raising flame temperatures with oxygen or enriched air Such differences are significant where radiation of heat is involved since the rate of transfer under such conditions varies as the difference between the fourth powers of the temperatures

Quite obviously, a vast new field of chemical operation as well as metallurgical processing is opened by the new era of "tonnage oxygen" that is now at hand The difference in degree between past and future is reasonably equivalent to a difference in kind Certainly the contrast is clear between the average output of two to three thousand tons of 99 5 percent oxygen *per year* of each of 222 present plants and prospective capacities of 120 to 1000 tons *per day* of 95 to 97 percent oxygen So too is the difference between $75 to $125 per ton of 99 5 percent gas and the prospective $2 75 to $5 21 per ton for 95 to 97 percent product Fulfillment of present plans will mark the beginning of new and efficient chemical production of many kinds

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SLIME PREVENTIVE

Developed For Industry, Found Beneficial to Fish

During extensive testing of pyridyl mercuric acetate for controlling the slime that plagues paper makers, the discovery was made that the small concentrations (about 1 in 7,000,000) of the fungicide that escaped into a stream actually promoted the health of the fish in its waters

Slime in paper mills originates from the growth of bacteria and fungi, and these are made much less vigorous by the addition of the pyridyl mercury compound In the same way, the health of the fish seems to be promoted by the suppression of the growth of micro-organisms in their watery homes Following the first observation of this effect, tests were made to confirm it under more closely controlled conditions, with the result that a fraction of a part of the fungicide per million of water is suggested for protecting young fish in hatcheries

STORED VEGETABLES

Kept from Sprouting by Application of Hormone

Important cause of spoilage of vegetables in storage is their sprouting under the moist conditions necessary for proper keeping, even though the temperature is kept quite low in the storage space This tendency of root vegetables, and tubers particularly, can be controlled to a considerable degree by the use of plant hormone substances which suppress sprouting Latest successful tests show that an easily applied methyl ester of alpha-naphthyl-acetic acid is effective in preventing sprouting spoilage of potatoes, carrots, and turnips This compound is closely related to the alpha-naphthyl-acetic acid which prevents premature dropping of apples and other fruits from the trees

All photographs courtesy Standard Oil Co (N J)

Testing the pool unit of the oil pool analyzer

PREDICTIONS by Electronics

Reducing Years To Minutes, an Electronic Analyzer Permits Engineers To Review Over and Over the Productive Life of an Oil Pool, Testing Various Operating Techniques. Data so Obtained — Unfailing Predictions of How a Pool Will React to Any Given Circumstances — Enable Production Men to Extract the Greatest Amount of Oil Most Efficiently

By JOHN MARKUS

Associate Editor *Electronics*

LIQUID black gold—oil deep in the bowels of the earth—is as inviting a treasure to man as the yellow metal itself. But perserverance in searching and drilling alone cannot insure anywhere near maximum recovery of the precious oil from between the particles of sand in underground pools. So science comes to the rescue with its electronic instruments for exploring oil sites, for guiding drills, and finally for determining the best way to get the most oil out in the shortest time.

Engineers know that if you take the oil out of a given pool too fast the pressure drops and no more oil comes up. So they compute, by means of involved mathematical equations, the rate of oil withdrawal that will best maintain an oil pool's pressure. But there have been two handicaps to this procedure, a staff of expert mathematicians had to labor for long periods of time to solve the complex equations, and some problems were so involved that even the best mathematicians could do no more than approximate the answers.

• LOOKING AHEAD •

Extension of principle to complex industrial heat-flow problems. Means of determining where and how to place heating ducts in buildings for highest efficiency. Engineers, physicists, and geologists relieved of involved mathematical chores

Today oil men have a robot mathematician, an electronic device called the oil-pool analyzer, which, in mere minutes, can work problems that calculators normally might take months to solve. Researchers had found that heat flows through a solid body much as electricity flows through a network of condensers and resistors, and that oil and water, under pressure in sand deep underground, behaves similarly. The flow of electricity can therefore be translated mathematically to represent the flow of either heat or liquids; this constitutes the principle of the oil-pool analyzer developed by Dr. W. A. Bruce in the laboratories of The Carter Oil Company.

Accuracy of the analyzer has been proved by feeding into it early data on oil fields which had been worked for some time. The predicted behaviors agreed exactly with what had happened in actual practice. Thus, the analyzer can look ahead 10 or 20 years, to tell at what rate oil may be withdrawn—or water or gas may be injected—so that enough presure will be left to produce a high ultimate yield.

The analyzer's chief use is in guiding production engineers as they plot the rates of withdrawal of oil in new fields. It also will be of value to universities where new generations of oil scientists are being trained, to state regulatory commissions interested in conservation and to industries having complex heat-flow problems.

An oil pool in miniature is the technician's device for representing a real oil field in the laboratory. Round tabs on a board indicate producing oil wells. The wells of this oil-pool unit are really electrodes connected in groups at the back of the board to simulate actual groups of wells draining an area of an oil pool. Some are producing wells while others are injection wells through which vast quantities of water may be pumped back into the earth to restore partially the pressure lost by oil withdrawal A glycerine-water solution, in which the electrodes stand, conducts electricity just as the sand far below ground conducts water and oil The solution also resists the flow of electricity as the sand resists the flow of fluids

ANALYZER FED FACTS—Into the oil-pool analyzer go such facts about a field as the number of wells, production rates, pressure history of the field from the start, amount of fluids withdrawn, and an estimate of the amount of water or gas that may be injected With this information to work on, the analyzer will forecast reservoir pressures far into the future, or tell the rate of oil withdrawal or the rate of water or gas injection that will make it possible to maintain a working pressure

There is a remarkable parallel between the way an electrical condenser can store an electrical charge and the way sand can store oil. The analyzer uses a bank of condensers to represent the capacity of the sand to store fluids But stored oil is of no value unless it will flow to the wells The analyzer takes flow into account by a set of electrical resistors These units resist the flow of electricity just as sand impedes the flow of oil A number of resistor-condenser units can be connected together to represent a large and complex liquid-filled porous medium, with the currents discussed in terms of barrels per day and the voltages in terms of pounds pressure per square inch.

Another big factor in the problem is time The faster oil is withdrawn —and with it gas and frequently water—the faster the pressure will drop In the timer cabinet, the analyzer squeezes months into seconds It is set so that 2½ seconds equal one month of the field's history and prediction Thus the machine works out a ten-year analysis of the pool in 300 seconds The analyzer can look ahead to tell what the pressure will be for each month for an assumed production rate.

With all the basic facts introduced, the analyzer can proceed with its problem The machine's heart and brains are its electronic tubes that control withdrawal of current from the condensers (representing oil or water withdrawn from the pool), and control current fed into the condensers (representing water injection wells) Similar allowances can be made for gas withdrawal and injection

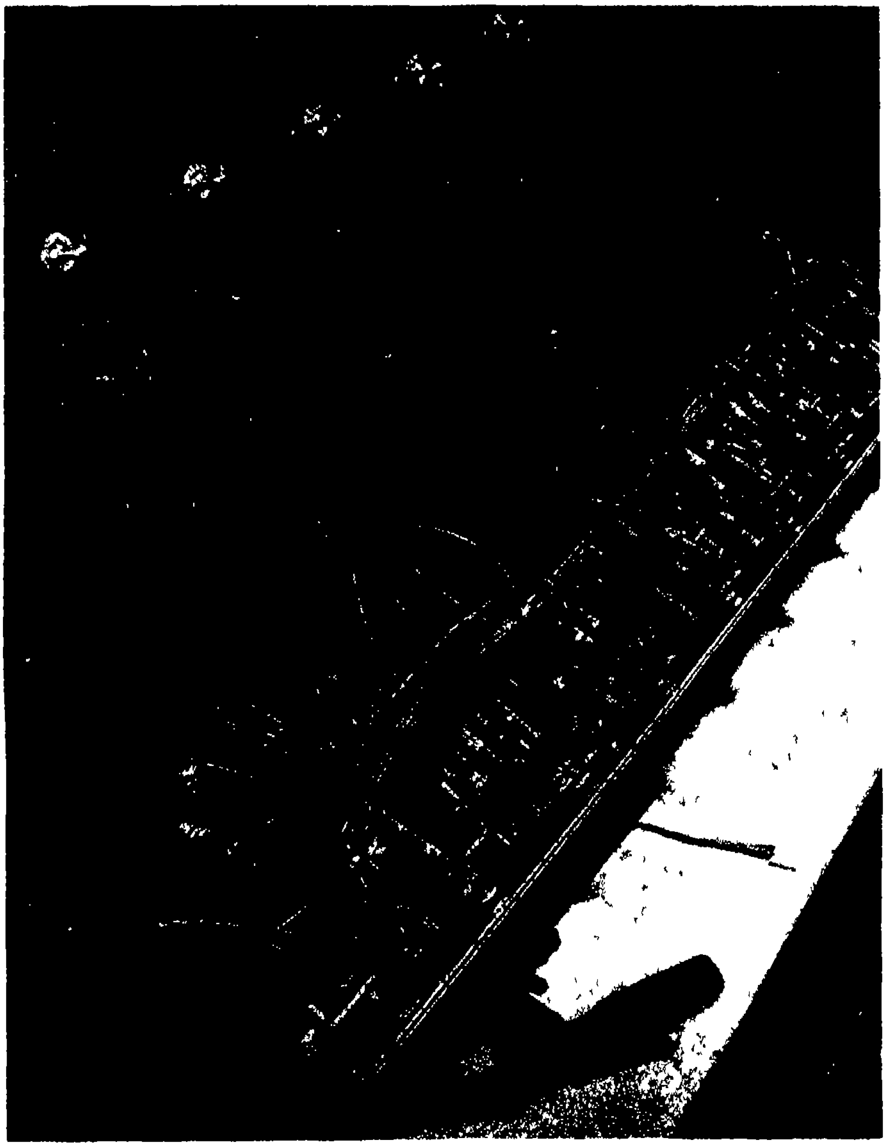
Other electronic tubes measure voltage on the condensers (underground pressure of oil and water) and amperes of current flowing (rate of flow of water and oil) These split-second computations, which tell how much fluid is flowing how fast, are the key to the analyzer's answer

FINDINGS CHARTED—The machine translates its findings electronically into lines on a chart that will go back to the geologists and engineers as a guide for future operation of the field

When the pool contains a single-phase liquid and does not develop a gas phase during the time under consideration, the entire problem can be set up in the analyzer, and studies made of the relationship between production and pressure or injection of water and pressure

When the reservoir either has a gas cap originally, or develops a gas cap phase later, it is necessary to determine the original volume of the oil zone and consider the behavior of gas in the reservoir This problem is treated by the successive approximation technique, in which the pressure-water influx relationship as shown by the analyzer is compared with material balance calculations, which in turn permits an adjustment of the pressure-water influx curve

SUCCESS IN ARKANSAS—The real proof of an analyzer's validity lies in its ability to follow a complicated pressure-production relationship with values for the condensers and resistors compatible with known geological data A particularly satisfactory result was obtained in the Midway pool in Arkansas, where predictions were based on a relatively short history The pool was discovered in January 1942, and predictions made in April 1943 indicated almost perfectly the effect caused by water injection. After a year of operation, however, the production and injection conditions were changed



A section of the panel of the oil pool analyzer has been pulled forward to show some of the controls that can be set to simulate conditions of an oil reservoir

With all the necessary information applied to the analyzer's control panel, the machine will simulate, on a miniature time base, the changes that would occur in an underground reservoir, represented by the circular tray at extreme left

so much that it was necessary to make a new prediction assuming the changed conditions, this was also followed perfectly through late 1944 and early 1945.

The solution of a problem encountered at the Midway pool in Arkansas illustrates the scope of the analyzer in dealing with complex problems. The Midway pool by April 1943 had 40 wells producing 175 barrels per day each. With this production, the pressure was falling at the rate of 0.5 pound per square inch per day. Two questions arose: (1) How much cutback in production would be necessary to arrest the pressure decline and (2) how much water injection would be necessary in the event it was attempted to maintain pressure by water injection on the flanks of the pool?

The problem was analyzed and it was found that reduction below 150 barrels per day would only temporarily arrest the pressure decline if no water injection were used. It was further found that if the production rate of 175 barrels per day were maintained, about 5000 barrels per day of water injection would be needed to hold the pressure constant. Measured pressures today show how well the analysis anticipated the behavior of the pool as it was operated with water injection.

Thus is electronics squeezing years into minutes, running life cycles of wells over and over again, and noting how much oil comes out each time, so that the one best operating technique for a particular well or field can be followed in practice.

In other industries, similar electronic analyzers can likewise speed up time, permitting engineers to peer far into the future. These electronic brains will answer such questions as how many dollars worth of fuel is saved in a home in ten years by installing storm windows, or how much fuel is saved in an average year by dropping the thermostat setting at night in a building. The more complicated the problem, the greater are the possibilities for real savings by finding electronically the best operating conditions.

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MAGNETIC SOUND FILM

Used in Making Home Talking Movies

APPLYING a magnetic coating to movie firm, for simultaneous recording of sounds during taking of home movies, is now a practical possibility. The magnetic track, only 0.0005 inch thick and 1/20 inch wide is put between the sprocket holes and one edge of the film during manufacture, and is unaffected by developing solutions. The magnetic head used both for recording and playback is spring-pressed against the film while it rides on a flywheel stabilizer. This head is easily mounted on conventional projectors, and can be connected to an ordinary audio amplifier and loudspeaker. With this technique, developed by the Armour Research Foundation, all sounds from 50 to 5000 cycles are satisfactorily handled on 16-mm film, for 8-mm film that moves at half the speed of 16-mm film, the upper frequency limit is about 2500 cycles, which is still adequate for clear and natural voice, but not as good for music.

RADAR ON AIRLINERS

Will Detect Bad Weather And Aid in Navigation

MODERN commercial radar equipment is being installed in eight Boeing Stratocruiser luxury airliners now under construction for American Overseas Airlines. Storm areas and regions of dangerous icing will be revealed by a radar antenna in the nose, pointing forward and shorelines will be mapped from many miles out to sea by a 60-inch diameter antenna in the belly, pointing downward.

PHONES IN TAXIS

Reduce Rates and Improve Cab Service

NEARLY 8000 taxicabs in the United States, comprising over 200 different fleets have already received authorization to use two-way radiotelephone equipment, and applications for thousands of additional units are rapidly being processed by the Federal Communications Commission. Largest grant went to a fleet of 1600 cabs operating in San Francisco and Los Angeles. Many users are reporting that the radio equipment pays for itself in less than a year in cutting down idle cruising time in the larger cities and in providing better, cheaper service in smaller communities doing a telephone rather than pickup business. Customers no longer have to pay meter charges on the run from the taxi terminal to their homes, as the radio dispatcher is generally able to find an idle cab within a few blocks of the customer and the resulting lower charges have greatly stimulated business.

HARDENABILITY

A Revolutionary Basis for Steel Specifications

By FRED P PETERS

Editor-in-Chief *Materials & Methods*

THIS IS the story of a mere technical trend that is becoming a revolution—of a concept of steel metallurgy whose commercial exploitation by industry as a whole is completely changing the basis on which the giant steel industry does business with the rest of American industry

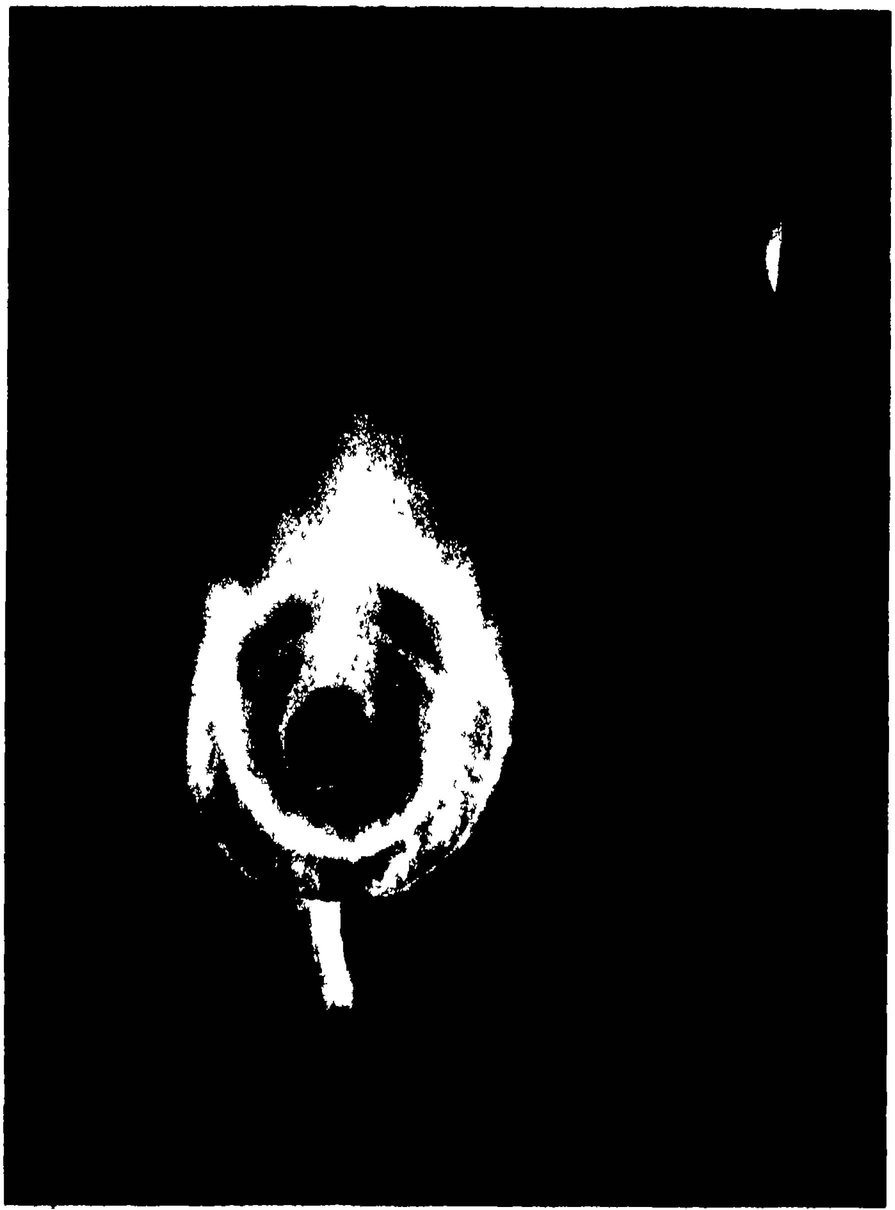
The concept is the "hardenability" of steel or, more significantly, the different hardenabilities of different steels The revolution is the growing practice of selecting and specifying steels on the basis of their hardenabilities, replacing the time-honored procedure of ordering steels to a specified standard composition It is of great importance commercially, because it is saving mass-production industries like the automobile manufacturers thousands of dollars annually on heat treating, inspection, and other production costs, while permitting the steel industry also to save much money previously spent in "adjusting" steel compositions during manufacture, so that the traditional "chemical analysis" specifications of the customer could be matched

As a commercial situation, hardenability has evolved its own somewhat hieroglyphic terminology, including "H" steels, end-quench tests, Jominy bars, hardenability "bands," and so on These are not nearly so formidable as they sound and should not be allowed to remain a barrier to the understanding and use of hardenability specifications by the people who can benefit most from them

For approximately half a century, chemical analysis has been the chief basis by which steels were graded, bought, and sold A steel user would decide that he required a medium-carbon, non-alloy steel for his product, and would then proceed to order so many tons of that standard steel whose composition seemed closest to giving him the properties he desired For example, he might have decided that this was S A E 1040 and when his steel was delivered, it

Courtesy Joseph T Ryerson and Son Inc

Quenching a Jominy hardenability test sample The quenching fixture is located close to the furnace (extreme right) to keep heat losses as low as possible while the specimens are being transferred from the furnace to the quench bath during the course of the test



Courtesy American Rolling Mill Company

In parts which must undergo heat treatment, such as this steel wheel shown receiving a full oil quench, hardenability is a factor of considerable importance

• LOOKING AHEAD •

Money, time, and temper saved by assuring that material has correct properties for the job. Adjusting composition during manufacture. Inspections and re-heat treatments by the fabricator greatly reduced. Steel performance rather than precise composition finding ever-increasing favor.

would indeed be found to contain between 0.37 and 0.44 percent carbon, 0.60 and 0.90 percent manganese, and so on, as set forth in the S.A.E. specification under which he ordered it.

AIDED MASS-PRODUCTION—The use of these standard specifications was a boon to industry, since it permitted the steel industry to mass-produce, at consequently lower cost to their customers, a relatively small number of standard steels. These steels, thus standardized, covered most of the requirements of the steel-using industries, which in turn were sure not only of receiving without undue delay whatever amounts they needed of them, but also that they would be reproducible from lot to lot or order to order. The steel mills employed thousands of chemists simply to make check analyses of heats of steel both during and at the completion of manufacture, and many of their customers also made chemical analyses of the steel on delivery, to be sure the steel fell within the specification.

The number of steels coming under the standard steel specification system steadily increased, particularly in conjunction with the spectacular expansion of the automotive and aircraft manufacturing industries. At the same time, these fields were coming to place ever greater dependence on *alloy* steels, for alloy steels as a group possess greater *hardenability* than carbon steels. (Hardenability should not be confused with hardness, hardenability in the sense in which metallurgists and the steel industry use it means not *how hard* a steel will become on heat treatment but rather *how deeply* the full hardening effect will penetrate large-size pieces and parts under normal heat treatment.) Steels of high hardenability were required for heavily stressed engine and transmission parts because such parts were large in section, and needed their maximum heat-treated properties throughout the section—not just near the surface, alloy steels, being higher in hardenability, gave this extra depth of hardening in oil-quenching treatments, without resorting to the drastic practice of water-quenching, which in large parts may cause cracking and distortion.

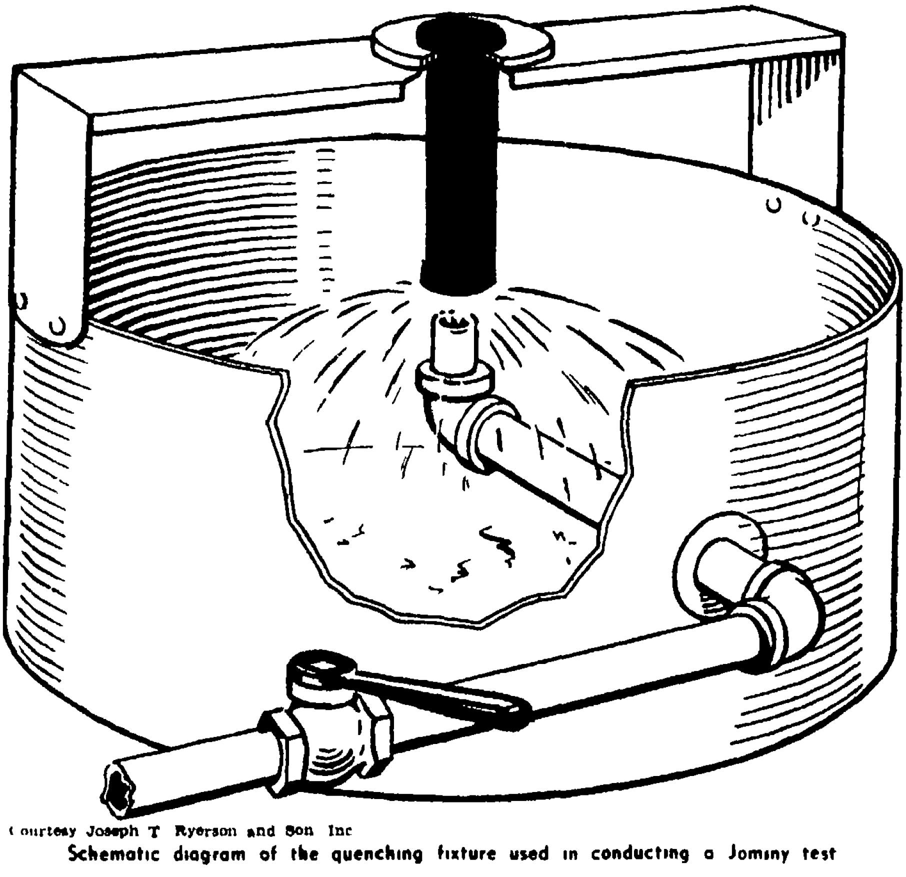
Since this characteristic of extra hardenability was one of the chief factors in the selection and application of constructional steels for engine and machinery parts, it was natural that metallurgists should begin to make intensive studies of hardenability, and especially as it is related to (1) the chemical compositions of steel, the traditional basis for their specification, and (2) other properties, such as tensile strength, ductility, and so on. They found that (a) hardenability is very closely related to the exact, accurately determined composition (including elements present in "trace" amounts), (b) it is, however, considerably affected also by such non-chemical factors as grain size of the steel as seen under the microscope, method of deoxidation during manufacture, and so on, (c) it is only loosely related to the composition ranges provided in the standard steel specifications, and (d) changes in hardenability generally run parallel to changes in other mechanical properties for a given type of steel.

METHOD INADEQUATE—On this basis, therefore, it was becoming clear that the most important factor in the selection of machinery steels was only inadequately reflected in the chemical composition method by which they were traditionally specified. Out in the auto and tractor and aircraft engine plants, these inadequacies of the traditional system were bing felt in very practical and painful ways Of several lots of the same steel that successfully fell within the composition range of the covering specification, some lots would have much higher hardenability than others, and the hardenability of a few batches might even be so far out of line as to make them unsuitable for processing in the automatic, production-line heat treating set-ups increasingly used Steel users therefore began to demand narrower composition ranges in the specs or asked for special grades to meet their own hardenability requirements, and the steel makers' costs began to rise in proportion

Then almost simultaneously several people perceived that the error lay in the basis for the standard specifications, and that if the steel maker were given plenty of latitude with respect to composition so long as he delivered steel within a narrow specified *hardenability* range practically everybody would be happy Thus were born the so-called "H" steel specifications of the American Iron and Steel Institute and the Society of Automotive Engineers, specifications which are the official culmination to date of the trend toward use of hardenability as the prime factor in choosing constructional steels

At present the "H" steel specifications cover a relatively small group of steels For each of these, a broader chemical composition range than the conventional specification is provided and a hardenability range or "hardenability band" becomes the specifying factor These bands enable the user to specify minimum and maximum limits of hardenability for a given type of steel, so that he may have better control of hardness variations from lot to lot and a minimum or an elimination of re-heat-treatments in production In ordering his steel, the user simply orders, for example, so many tons of 8620H, instead of just 8620 and specifies the hardenability requirements it must meet When he receives it, the steel will be uniformly within the hardenability range or band for 8620H but may be inside or just outside the composition range of the standard 8620 chemical composition specification

Testing hardenability of steel has thus become virtually as important as determining its chemical analysis has been to both steel makers and steel users for the past several decades Indeed, the hardenability test has already taken its place beside the hardness tester (Rockwell, Brinell, and so on) and the metallurgical microscope as the most important means of evaluating steels for production, acceptance checking, or research Thousands of hardenability tests are now made in this country every month, and there is accumulating a vast body of data on the hardenability of individual steels which will without question be used in extending the "H" type of specification to many other steels in addition to the few now covered by them.



Courtesy Joseph T Ryerson and Son Inc

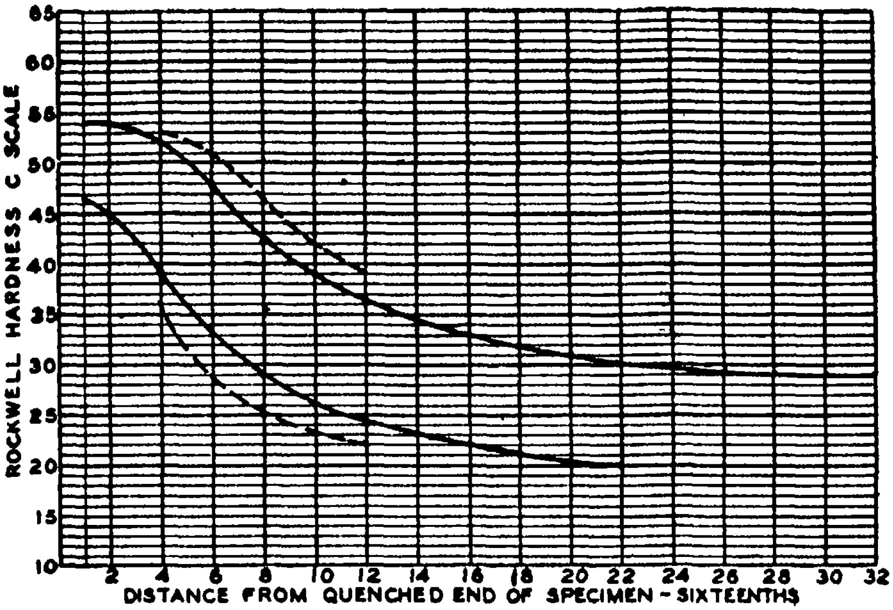
Schematic diagram of the quenching fixture used in conducting a Jominy test

HOW STEEL IS TESTED — These tests are all made by a standard procedure, called the "end-quench" test, developed a few years ago by two General Motors metallurgists, Jominy and Boegehold The test consists of water-quenching one end of a properly heated standard flanged one-inch diameter bar of the steel in question (often called a Jominy bar) and measuring how far from the quenched end the steel is fully hardened In addition to providing a means of checking or comparing the depth-hardening characteristics of different lots of steel, the Jominy test gives much other useful information about the heat-treated properties of an individual steel—the maximum hardness that it could probably achieve under the most favorable hardening conditions, the mechanical properties it will develop under those same conditions and so on At the present time, it is easily the best all around test for evaluating steels on a probable performance basis available to industry

From all over the country and from steel users in several industries have come reports of better quality, fewer rejects, and lower operating costs because of attention to the hardenability of the steel used, and especially through the use of the new 'H' steel specifications One large producer of agricultural equipment, for example, states

"Before going to the 'H' steels, we accumulated considerable data on the alloy steels which were being supplied to us on a chemistry specification We were able to work up hardenability bands to cover all the steels that had been supplied to us over a period of time We were then able to sell our engineering department on the proposition of changing our specifications to permit the wider chemistry that would, in turn enable us to secure narrower ranges of hardenability and better production control We have continued making hardenability tests on each heat of steel, and we can say that every heat of steel that we have purchased on the 'H' specification has come within the specified band We are definitely obtaining a closer range of hardenability by the use of the 'H' steels"

EXAMINATION NEEDED—The use of hardenability bands rather than straight chemical composition limits



Courtesy American Iron and Steel Institute

Hardenability band for an H steel (solid line) shows a narrower range than does the band of its counter part (dotted line) specified by chemical composition

will impose upon the consumer of steel the necessity for examining each steel part made in his shop, determining the hardnesses of critical areas of those parts, and comparing them with the hardnesses shown on the end-quench test curve for the same steel In spite of the seeming complexity of this job, it is one that can be done without elaborate equipment, and which will pay substantial dividends to the men or companies who adopt the idea and carry it out faithfully

On his part, the steel maker, by obtaining wider leeway in the specified percentages of carbon, manganese, nickel, and chromium can deliver a steel more closely controlled as to its really important physical properties than he could under the chemical composition method of specifying The reason for this apparent anomaly is the fact that he can balance his composition as a result of test analyses run while the steel is still molten and before it is poured, to bring the steel within the desired hardenability range He could not do this if he had to be sure to stay within a narrow composition range

Within a relatively short period as a result of joint committee activity of the American Iron and Steel Institute and the Society of Automotive Engineers other important alloy steels will become the subject of "H" specifications and eventually the hardenability bands will be formally and officially agreed upon and standardized This will complete the first major step in transferring the selection and specification of metals and their alloys from the venerable chemical composition base to the more significant basis of performance characteristics Metallurgists with an eye on the future say other materials and other properties are sure to follow along this progressive path

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CARBIDE GUIDE-REST

Lasts Eight Times as Long as Cast Iron Piece

Cemented carbides, well established in use for cutting tools and wire-drawing dies are rapidly invading the field of hard, wear-resistant parts and machine components

For example, a New England machine-tool builder recently reported rapid wear on the cast iron guide-rest in a circular die roll threader, caused by the rotation of hard steel blanks during the roll threading operation Wear was so severe that the guide-rest had to be reground to the required flatness after each lot of 9000 pieces

In an effort to eliminate excessive regrinding and setup time, the guide-rest was tipped with Carboloy cemented carbide Production between regrinds rose to an average of 74,000 pieces Moreover, each regrind of the guide-rest required the removal of only 0 001 inch of carbide

The problem of marring of the guide-rest surface by scored threads was eliminated, the carbide guide-rest surface being so hard that scored surfaces of threads were not reproduced on it

SPRING MATERIAL

Is Resistant To "Set" and Corrosion

Developed for use in mainsprings of watches, a new alloy is a cobalt-base product, containing 40 percent cobalt, 20 chromium, 15 5 nickel 15 iron, 7 molybdenum, 2 manganese, 0 15 carbon, and 0 03 berryllium Tests have shown watch springs made of this alloy, called Elgiloy to have several times the life of ordinary carbon steel mainsprings, not only because of greater strength and resistance to "set," but also because of its exceptional corrosion resistance They are for all practical purposes unattacked by even corrosive atmospheres—atmospheres that "eat up" a carbon steel spring in a matter of months

The new alloy is surprisingly easy to fabricate, either hot or cold, and does not require quench-and-temper heat treatment as does carbon steel The Elgin National Watch Company who developed the material, have used it in mainsprings for nearly a year without a single failure Studies are currently underway on other applications for the material in various high-temperature uses such as in jet engine parts

ELECTROSTATIC PAINTING

Proves Economical On Large Scale

Electrostatic spraying, widely used during the war for rapid application of paint finishes on small parts, is now increasingly used for larger units Typical of the latest of these large-scale systems is the mechanized installation for electrostatically spraying steel wall panels about 93 inches high and 24 inches wide, with attractive finishing coats at the Martin-Parry Corporation

The success achieved is represented by Martin-Parry's comparative figures With ordinary spraying 60 gallons of paint was required to coat about 500 panels After adopting the electrostatic spraying method, the same quantity of paint would suffice for 944 panels An overall saving of more than one third was reported in the quantities of mixed paint used Labor costs have gone down, too Whereas 21 men were needed to operate the previous system, the present force consists of only eight men, turning out 25 percent more production Floor space needed for the present system is one third less than that previously required

WHERE DO Plastics GO FROM HERE?

Present Suppliers of Coal-Derived Chemicals Cannot Keep Pace With the Combined Requirements of the Rapidly Expanding Plastics Industry and With Other Equally Fast-Growing Non-Plastics Markets As A Result of This Fact, Are the Present Ambitious Plans for Plastics in the Coming Year Doomed to Only Partial Fulfillment?

By CHARLES A BRESKIN
Editor Modern Plastics

IS THERE a ceiling on plastics expansion? As far as end products are concerned, there was the feeling, until the very recent past, that everything and anything could be made of plastics Fortunately, this "Plastics World" idea is gradually being abandoned as the industry gains more and more experience in just what can and cannot be done with these materials Some applications have been discarded entirely because they represent uses in which plastics can, at best, be only substitutes. But just as fast as these poor applications have been weeded out, they have been replaced—more than replaced, in fact—by new outlets in which plastics meet the operating conditions better than do other materials In many instances, plastics have created applications for themselves, applications which were unthought of before the arrival of plastics with their unique characteristics

A somewhat similar misconception has existed—and still exists—regarding the basic materials from which plastics are produced It has been assumed that since the chemicals on which plastics production depends are derived from such abundant materials as air, water, and coal, the supply is virtually unlimited A common impression is that the chemist dumps coal into a hopper and, by some miraculous transmutation, extracts plastics at the other end of the machine The fact that these natural materials can not be used directly for the processing of plastics is entirely overlooked Actually, only a small fraction of the coal mined is of use for plastics production and the dollar value of the chemicals derived is only a fraction of the total cost of the coal It is obvious, then, that because of these economic factors, the derivation of coal chemicals for use in producing plastics materials must be secondary to other uses of coal Thus we have the strange situation of the great plastics industry depending on the by-products of other industries for its essential supplies

Today it the steel industry that provides most of the basic chemicals for plastics materials The greatest sources are the coal tars and light oils that are by-products of the coking process, and the steel plants are, of course, the major producers and users of coke, although a small amount comes from artificial gas producers These tars and light oils can be refined to obtain such coal chemicals as benzol, phenol, cresylic acid, and naphthalene Simple dependence on the steel industry would be bad enough, but there are other complicating factors, plastics processors, for example, are not the only bidders for the available supply of chemical-laden tars and oils

The ceiling on plastics production depends, then, on the following factors 1 The total amount of coal chemicals available from present sources 2 The relative proportion of these materials that plastics can expect to obtain in a competitive market 3 The development of new sources for the necessary base chemicals

In an expanding economy that sees an increasing demand for plastics products, it is reasonable to assume that there will be a concomitant increase in the demand for steel This would be fortunate, for the expansion of steel production would increase the supply of coal chemicals The situation is beclouded, however, by the fact that the chemical supply does not increase in direct ratio to steel production An accompanying chart shows the relationship between steel ingot production on the one hand, and coal tar and benzol (one of the chief chemical derivatives of light oil) on the other While steel production was increased during the war by 50 percent over its pre-war high, coal tar production went up less than 30 percent

WHY TAR IS SHORT—Authorities offer a number of explanations for this situation Among the reasons is the faster-than-normal operation of coke ovens due to heavy demands

Year	Steel Ingot	Coal Tar From Coke	Benzol[1]
	tons	gal	gal
1937	57,000,000	603,000,000	
1944	89,000,000	772,000,000	178,000,000
1945	80,000,000	696,000,000	156,000,000
1946	66,000,000	600,000,000	135,000,000

[1] Not including motor grade

Steel production compared with coal tar and benzol outputs for steel, for fast operations reduces the amount of coal chemicals obtained Then, too, coke ovens are worn out from excessive operation which, in turn, has decreased the yield of coal chemicals Use of poorer quality coal for coking also results in a lowering of the average number of gallons of coal chemicals obtained per ton of coal (The average for good coal is eight gallons with the quantity ranging from six to 12 gallons, depending upon the volatile matter of coal) Perhaps the greatest single factor contributing to the lower ratio for coal derivatives is the use of bee-hive coke ovens for a portion of the coke needed when demand for steel is above normal requirements No chemicals are recovered from these ovens

Many of these factors were, of course, the products of war-time emergency measures It can be anticipated, for example, that the ratio of coal tar produced per ton of coke may increase slightly when new ovens come in and slower coking is again practiced That increase, however, may be offset by new processes using oxygen in blast furnaces, which will decrease the total amount of coke required for steel production

The second possibility for raising the ceiling of plastics production would be the purchase of a greater proportion of the total coal chemical supply for plastics processing This may develop into a monumental economic struggle, because many other industries have an equally urgent need for coal chemicals Even considerations of national defense and international politics enter the picture

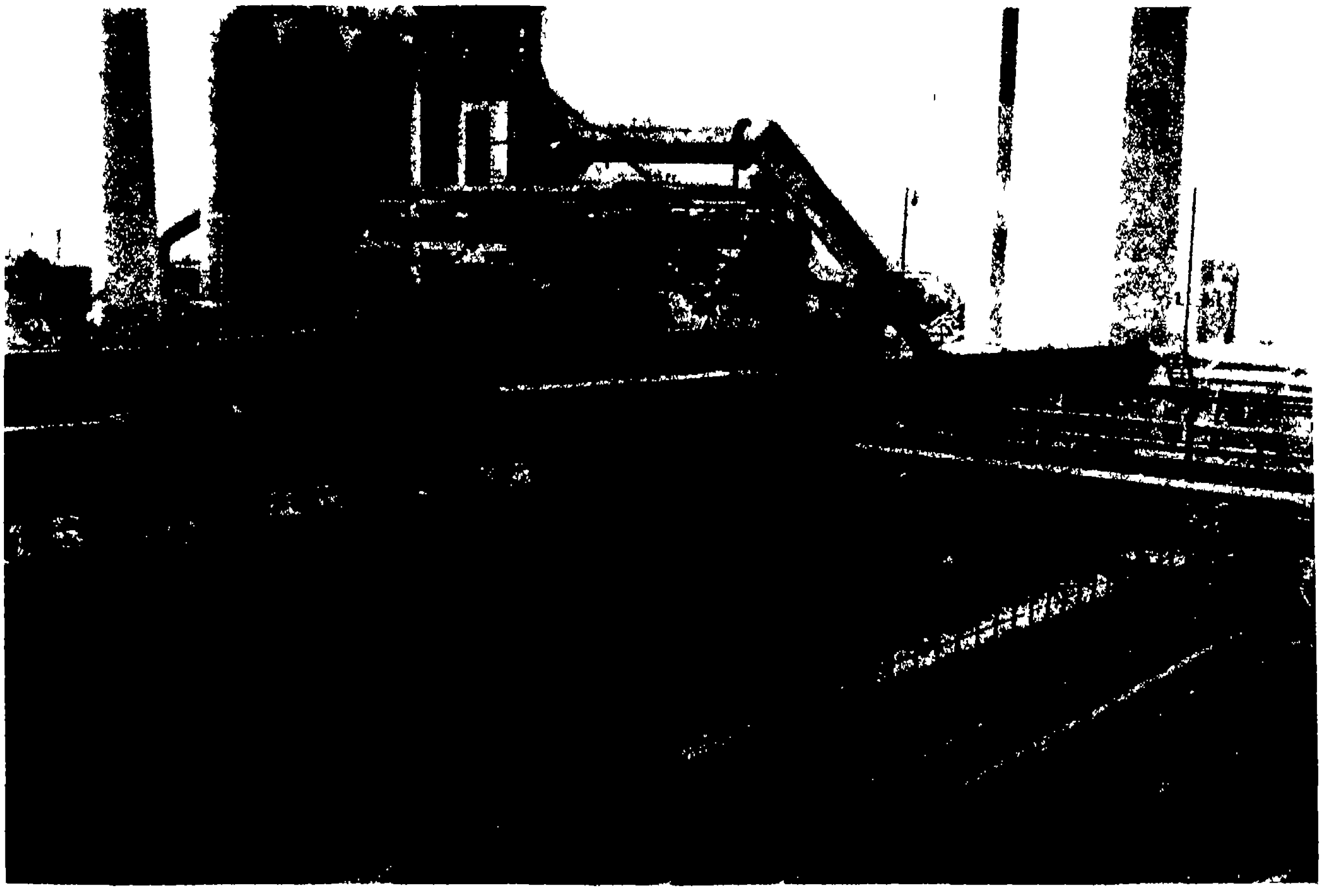
While it isn't feasible in this limited space to discuss all the chemicals derived from coking, the general situation should be clear from a consideration of the competition for one major chemical—benzol

BENZOL WIDELY NEEDED—Benzol has many important uses within the plastics industry, being a necessary ingredient of polystyrene and of phenol

Polystyrene is an increasingly popular plastics which has expanded phenomenally from a production of 750,000 pounds in 1939 to 60,000,000 pounds in 1946, and is expected to reach 200,000,000 pounds annually by 1948—a production that would account for 35,000,000 gallons of benzol Because of its low price and its low specific gravity, it is popular for such applications as interior refrigerator parts, household equipment, toys, containers, and so on Formulations can be built that have special characteristics such as high heat resistance, high-frequency dielectric qualities, and great flexibility It has possibilities for impregnating, bonding, and laminating, for coatings of all types, and for adhesives and extrusions As a foamed or fibrous substance, it has been suggested as an insulation material

Phenol is perhaps the most familiar of all the plastics—the established material for housings of business and adding machines, many telephone sets, radio set housings, and innumerable other articles in common use Phenolics always have accounted for a large percentage of plastics business and, though recently other materials have attained a slightly greater volume, the demand for phenol is still expanding Part of this is due to a trend toward heavier and larger molded pieces, coupled with doubled or tripled processing speed attributable to the greater use of electronic preheating and plunger molding Thus, phenolic production rose from 65,000,000 pounds in 1939 to 140,000,000 pounds in 1946, with a predicted level of 170,000,000 pounds in the current year—a production requiring 20,000,000 gallons of benzol

NON-PLASTICS COMPETE—Competing with polystyrene and phenol for the limited benzol supply are such non-plastics markets as syn-



Some of the most essential chemicals of plastics manufacture come from such coking ovens as these thetic rubber, dyes, medicinals, rubber, camphor, detergents, insecticides (D.D.T.), and other products.

The synthetic-rubber industry grew to spectacular size during the war to supply the requirements of a nation and military machine cut off from its supply of natural rubber. With the re-opening of trade with the East Indies and Southeast Asia, it was natural that production of synthetics should decline sharply. Still, in 1946, more than 600,000 tons of GR-S rubber were manufactured in this country. Two factors militate against a much greater decline. First, the improved quality and decreased price of the synthetic product have given it a good competitive position with regard to natural rubber. Second, and most important, the synthetic rubber industry is an important element in the defense program. With China, Indo-China and India in ferment, and with international tension still high throughout the world, it is unlikely that the United States will allow too large a segment of this essential industry to fall into disuse. If production is maintained at a level of 500,000 tons, the benzol requirement will be 43,750,000 gallons.

It is estimated that the dye industry can use 20,000,000 gallons of benzol if it is available. Another 20,000,000 gallons would find a ready market in detergents, D.D.T. and miscellaneous products. Adding the plastics and non-plastics uses detailed above, the demand for benzol next year might well reach a total of 138,750,000 gallons. As shown in the accompanying table, benzol production in the United States in 1946 was 135,000,000 gallons. It is apparent that the nation is fast approaching a precarious balance between supply and demand. Expansion of the using industries beyond the levels anticipated in the near future would be impossible without an increase in the supply of benzol.

It is believed that a considerable quantity of benzol could be obtained at a price slightly above the prevailing level by scrubbing coal gas more thoroughly and further refining the better grades of motor benzol for recovery of chemical grade benzol.

BENZOL AND TOLUENE—Petroleum offers another possible source since benzol can be obtained at the same time as toluene in the petroleum cracking process. Toluene was obtained from petroleum in great quantities during the war, but it was not seen fit to take out the benzol at that time. So far there has been no great enthusiasm shown by the oil companies for the development of benzol production, but it is believed that experimental work has been carried on to a point where production could be undertaken within a reasonably short time if the oil companies were assured of a permanent future market at a price higher than that now prevailing.

Little is known about the development of the natural gas process for obtaining benzol or phenol, but it might not be too bad a gamble to wager that, when coal-processed benzol falls too far short of filling demand, natural gas may become the provider. A limiting factor is the possible future exhaustion of natural-gas supplies.

There is always the possibility that plastics materials producers will find other source materials to use in place of or to supplement benzol. Finally, work on extenders may develop to a point where much less phenol is required. Most companies have been furnishing extended phenol compounds over the past few months to conserve their phenol supply and it is possible that this practice will continue indefinitely with the extended resins selling at a lower price.

Although the plastics industry is by no means doomed to a stunted growth by the lack of raw materials, it is about to venture into new and uncharted territory. The next year or two will be the critical period while the industry approaches the limits of existing supplies and potential new suppliers of basic materials wait to see the extent of demand and the stabilized price level.

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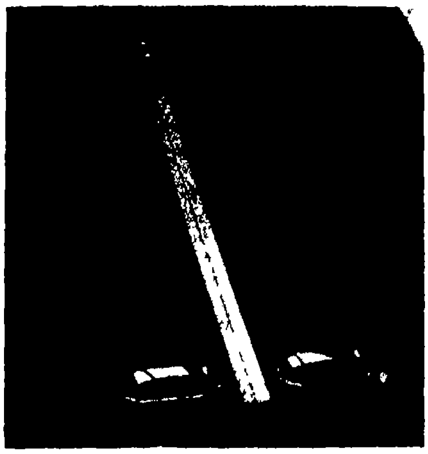
ACRYLIC LIDS

Provide Strong Tops For Merchandise Cabinets

A WHOLE NEW field of possible plastics applications is opened up by the transparent acrylic lids that are now being used on the Biltwel frozen food cabinets made by Fraser and Johnston Manufacturing Company.

The purpose behind the development of these lids was better merchandising. The freezer company wanted some type of covering that would invite the shopper to reach into the cabinets for frozen peas, strawberries, corn, and so forth. Acrylic material was finally selected in preference to glass for a number of reasons.

In the first place, acrylic lids drawn from 3/16 inch Lucite by K-Plastix, are strong enough to support a shopping bag filled with over 10 pounds of groceries even when this weight was placed at the very center of the lid—the weakest section. The second advantage of acrylic was that it fogged only slightly around the edges when formed into the domed shape desired. Then, too, the acrylic has the dimensional stability necessary for this application and is easily cleaned.



Two plastics lids hinged together

DISPLAY BOTTLE

Made of Acrylic, Is Light-Weight, Resists Breakage

TYPICAL of the wider use that is beginning to be made of plastics in large-scale displays is a Royal Crown Cola display shaped like a bottle. The bottle is fabricated by Arnold Plastic Company of one-quarter inch acrylic, and is processed on the inside with decals to simulate a label. The cap is also of acrylic, opaque material in this instance.

Large but light and strong

Diesel Power Comes of Age

By N C DEZENDORF
Director of Sales and Service Electro-Motive Division of General Motors Corporation

• LOOKING AHEAD •
The railroads' complete abandonment of steam for Diesel power just over the horizon Diesels used in many fields from which their former size and weight per horsepower have long barred them Diesel-powered passenger automobiles more than an engineer's day-dream *Competitive balance restored to transportation*

Now That Many of the Factors Which Formerly Militated Against Its Wider Application Have Been Overcome by New Refinements, the Diesel Engine Appears to be Ready to Realize its Fullest Potentialities

THE DIESEL engine today is on the threshold of achieving many of the objectives its enthusiasts have been claiming for it during the past 40 years This is the opinion of Charles F Kettering head of General Motors Research who has been intimately associated with Diesel engine development since 1928 Events of the near past and in the making bear out this prophesy

Probably no source of power except the atom, has been given greater publicity than the Diesel engine It is a household by-word denoting the last word in internal-combustion machines People for years have awaited the arrival of Diesel powered automobiles while condemning the seeming slowness of manufacturers in making this development available to them School boys who now are grandfathers were taught that the efficiency of the Diesel engine far out-distanced that of the simple steam engine by as much as 5 to 1, and even surpassed the steam turbine by from 10 percent to 50 percent depending on the type of application Little wonder that the public gave the Diesel so much attention

The first commercially successful American Diesel engine was built in St Louis in 1898 It was a 60-horsepower, two-cylinder affair weighing about 300 pounds per horsepower Dr Rudolph Diesel had patented his engine in 1892 but did not construct a successful model until 1897 The enterprising St Louis builder did not let any grass grow on his enthusiasm for this new source of power before he decided to do something about it Within a few years literally hundreds of engine builders in America and Europe were applying for licenses and were building various types of Diesel engines for specific power uses

But with all of this publicity and the enthusiasm of so many builders the Diesel engine was able to achieve only limited application Two barriers prevented the widespread use of this efficient power plant—weight and cost These barriers presented a challenge to engineers and engine manufacturers for many years, a challenge which has only recently been met Until the last 15 years the predominant uses of the Diesel engine were in stationary power plants—such as pumping stations electric power generation, and mill operation—and for marine purposes These applications were characterized by slow engine speeds and constant loads Given these conditions many Diesel engines had established noteworthy records of economy and reliability The barrier of weight and with it, size in higher horsepower ranges, prevented its application to most mobile uses Engines of 200 pounds per horsepower were

All illustrations courtesy General Motors Corporation

Diesel locomotives are now in the mass production stage

Engineer's cab of a Diesel locomotive (above) is clean and comfortable Engine room with 1500 horsepower Diesel engine (left)

common in these applications A 600-horsepower Diesel engine would weigh about 60 tons

SOUGHT IMPROVEMENTS — In 1928, Mr Kettering set out to do something about the improvement of the Diesel engine Development work by the General Motors Research Division under his direction resulted finally in the production of a two-cycle engine with many new features The first two engines of this design, each rated at 600 horsepower, were placed on exhibition at the Chicago World's Fair in 1933 The importance of this development can best be illustrated by the fact that the weight of this new Diesel was reduced over 80 percent and size over 75 percent from contemporary engines of comparable horsepower In addition, the new engine possessed characteristics which adapted it to varying loads and engine speeds In other words, it was made to order for mobile applications, with weight characteristics of less than 20 pounds per horsepower

There still remains the barrier of cost The Diesel engine, even the two-cycle, 20 pounds per horsepower engine, is an expensive engine to build We are accustomed to hearing gasoline engines referred to as "high-compression" engines and it is true that the compression ratio of gasoline engines has been gradually increased in the interest of greater economy and better performance Yet a high-compression gasoline engine has a ratio of only 6 to 1 in comparison with 16 to 1 for the average Diesel. In other words, the Diesel engine must be built to withstand more than three times the cylinder pressure of the gasoline engine This means larger bearings, heavier crankshafts, stronger metals, and more accurate machining to finer tolerances Fuel injectors are more costly than carburetors Hence, modern Diesel engines may cost several times the amount of gasoline engines of comparable horsepower This limits the application of them to uses where fuel and maintenance economies can offset higher first costs In general, Diesel engines of modern design are finding their best mobile applications in heavy-duty trucks, tractors, buses, boats, and railroad locomotives Today, the Diesel engine is rapidly becoming the heavy-duty work horse of America

ON HIGHWAYS — Unfortunately, the statistics available concerning the number of Diesel-powered vehicles in operation are meager However, the growth of Diesel-powered trucks tractors, and buses has accelerated during recent years In 1938, only one truck in every 10,000 was Diesel powered By 1941, it had increased to one in every 1000 Today there are two to every 1000 and the proportion will increase as full-scale production is reached It is a safe prediction that the majority of heavy duty, long-distance trucks will be Diesel-powered as quickly as they are made available by the manufacturers

Tractor statistics are almost nonexistent A survey made by the United States Public Roads Administration in 1941 showed 3200 Diesel powered tractors in operation out of a total of 121,000 In recent years, nearly all of the tractors used in heavy construction and road building have been Diesel powered

There are some 80,000 buses licensed in the United States and the number has remained fairly constant since 1938 During that time the proportion of them powered by Diesel engines has grown from 1/4 of 1 percent in 1938 to 2 percent in 1941 to 10 percent in 1946 A large proportion of street buses in metropolitan cities and the long distance inter-city buses are Diesel powered today and the trend will continue

AFLOAT — Use of Diesel engines in the marine field expanded so rapidly during World War II that by the end of hostilities the United States Navy had more Diesel horsepower in operation than steam Most of this Diesel horsepower was in the smaller, more agile boats such as tow boats, landing craft, submarines, sub-chasers, destroyer escorts, and destroyers It is a little-known fact that the advent of the General Motors Diesel engine in 1933 freed the submarines of the United States Navy of dependence upon a Diesel engine made under German patents and that this new engine was so much smaller and lighter than the European engines that it immediately doubled the range of the American submarine Because so much more space and weight could be devoted to fuel, we actually had submarines in World War II that could go from Seattle to Tokyo and return without refueling

Development of the so-called high-speed Diesel, operating at speeds up to 2000 revolutions per minute in the smaller landing craft and up to 800 revolutions per minute in the engines for the larger boats such as submarines, LST's, and destroyers, hastened the marine application

The Navy experience has resulted

in a distinct trend toward Dieselization not only of smaller commercial craft but also of larger boats Freighters of 5000 tons are being repowered with groups of Diesel engines driving generators which supply electric current to motors that operate the propellers There is a strong trend toward Diesel engines for river towing and pushing craft because of their greater speed and economy.

ON THE RAILS — The most spectacular results from the application of Diesel power have occurred in the railroad industry The growing fleets of Diesel-powered passenger trains such as the Zephyrs, the Twentieth Century Limiteds, the Super Chiefs, the Cities of Los Angeles, San Francisco, and Portland, the Rockets, the Capitol and National Limiteds, the 400's, and more than 150 other trains in daily service throughout the country have operated at capacity while establishing enviable records of clean, on-time performance, unequalled in railroad history

In the transcontinental field, the Diesel-powered Santa Fe and Union Pacific premier trains were the first to reduce schedules from 56 hours to 39¾ hours These trains have operated continuously since 1938 with hardly a vacant seat The Great Northern has just Dieselized its daily Empire Builder between Chicago and Seattle, and in the East, the B and O offered the first all-Diesel trains from Chicago to Washington and New York in 1936 Since then, the 20th Century Limited has been powered by Diesels which have rolled up more than one million miles in the past 19 months of operation In the South, the Seaboard, the Atlantic Coast Line, the Florida East Coast, the Southern, and the L and N have all swung to Diesels for passenger train operation

As spectacular as some of these applications of Diesel power to railroad service have been, even greater results are to be expected in the near future During 1947 it is planned that every principal through passenger train between Chicago and the Pacific Coast will be Dieselized with further reduction in scheduled time and with much more frequent service In the East, both the New York Central and the Pennsylvania have announced the order of sufficient Diesel equipment to Dieselize all of their first-class through passenger trains between New York and Chicago and St. Louis Many of these trains will be Diesel-powered during 1947 In the Southwest, the Missouri Pacific is expanding its Diesel fleet and will improve schedules of both passenger and symbol freight trains The M K T and the Texas and Pacific also will receive new mainline Diesel power The Cotton Belt and the Kansas City Southern intend to amplify their Diesel equipment and improve their services

STEAM ELIMINATED — But the most dramatic development—and the one fraught with the most significant and far-reaching possibilities—concerns plans for 100 percent Dieselization During the past year the Electro-Motive Division has been invited to co-operate with ten important railroads in the preparation of studies to Dieselize all or important sections of their lines Some of these studies are so well advanced and have been so well received by railroad managements that the eventual carrying out of them is already assured

While the benefits of Diesel power to the traffic man and shipper are already apparent, the eventual complete Dieselization of important railroads will bring a few more surprises The economies possible from the complete elimination of steam facilities are so great that railroads, which have found it difficult, if not impossible, to stay solvent whenever traffic falls off over a protracted period of time, will be able to withstand much more severe traffic fluctuations and still remain healthy In favorable years, sufficient earnings will be available to undertake badly needed improvements to plant and equipment, and thus improve services in the interest of shippers and the travelling public No medium of transportation can maintain its position successfully against new forms of competition if it lacks the earning power to modernize its equipment and promote its services to the maximum The shift in traffic which occurred from the railroads to trucks and buses was caused as much by neglect on the part of the railroads in matching the services offered by these new forms of transportation as by the subsidies in highway construction which are usually blamed for it

The rapid expansion of airplane usage occurred at a time when the railroads were confronted with financial problems of the first magnitude Many were in bankruptcy or receivership They were therefore prevented from matching many of the improvements in service—aside from speed alone—which attracted both travellers and shippers As a result, much traffic was diverted to airlines, in addition to that which would have been attracted naturally by the faster speed at higher cost.

The Diesel passenger, freight, and switching locomotives have proved themselves to be the most effective tools ever offered railroad managements for modernizing their services and for restoring the competitive balance against other forms of transportation in favor of the railroads The rapid increase in the use of this power has resulted from the demonstration of its ability both to improve services and to reduce operating costs These demonstrations up to now have been limited to direct operating economies while maintaining all of the expensive steam facilities

No tool—no matter how efficient or how superior to other tools—will by itself bring about great changes or improvements in methods Man is a creature of habit It takes a long time to make him fully alive to the potentialities of a new tool A steam man is slow to become a Diesel man

The Diesel engine in its present state of development is still a new tool as applied to mobile services How effectively management extends itself to utilize to the maximum the full potentialities of this engine will determine how rapidly the heavy-duty transportation facilities of this country are modernized and placed in a position to compete successfully with other forms of transport

* * *

NYLON STAPLE

Can Increase Strength Of Many Fabrics

Socks that almost eliminate darning, infants' soft sweaters that can be sterilized by boiling, and upholstery with amazing wearing qualities are in prospect as a result of limited commercial production of nylon staple fiber scheduled for mid-1947 The fiber to date has been produced only experimentally Other prospective uses are for seersuckers, sheer lawns, bedsheets, and rugs with crush-resistant pile that withstands constant foot traffic

The new textile fiber, made of nylon in short and fuzzy lengths, for use alone or blended with other staple fibers, is expected to have a fundamental influence on the textile industry because of its unique properties Nylon's strength is about five times that of untreated wool, its abrasion resistance about three times as great. Its stability in washing, combined with wool's resilience and resistance to wrinkling, make the two fibers natural complements Because nylon is non-irritating to the skin, wool-type garments of the spun fiber will be especially welcomed by people who are allergic to wool

Blended with cotton, spun nylon contributes not only longer wear, but quicker recovery from wrinkling, faster drying, and a softer fuller hand

The synthetic fiber's resistance to moths and mildew are other qualities that broaden its practicality in many of the uses forecast for fashions and home furnishings

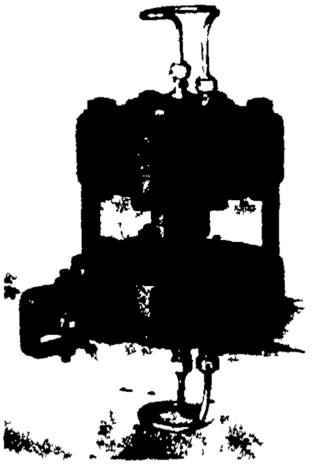
TORQUE TESTS

Aid in Bettering Motor Car Performance

Automobile manufacturers, anxious to improve the performance and lengthen the life of their products, are leaning more and more toward torque testing as a means of obtaining data on engines, axles and so on The Buick Division of the General Motors Corporation, for example, is running engines through exhaustive tests, using dynamometers and the Hagan Corporation s Thrustorq units to measure force and horsepower

In developing this procedure, it was felt desirable to test engines at approximately the same angle at which they will operate in the finished automobile As a result, the present dynamometer installation is tilted 10 degrees from the horizontal This permits operation of the engine at angles up to 20 degrees without a serious angular deflection in the universal joint which transmits engine power to the dynamometer If desired, the dynamometer could be mounted at any angle from horizontal to vertical

Buick is using the Thrustorq for both endurance and power runs Standard practice involves running the engine for 100 hours and then taking it off the stand It is then completely disassembled and checked for wear After the check-up it is again placed back on the stand and run to failure at continuous speeds well above those expected to be developed even in abnormally high-speed operation of the finished automobile The Thrustorq, which measures force as the product of an accurately-measured air pressure acting on a precision diaphragm, has several advantages—it has no knife edges to wear, causing inaccuracy, it can be mounted in any position and at any angle, and readings from the tests can be made at any desirable remote point. Also, it can be hooked up with any reasonable number of force or torque indicators



The highly sensitive double Thrustorq is operated by means of compressed air

Two other major tests are now being planned at the Buick Division, each to be equipped with Thrustorq units One will be in connection with a Gleason axle-testing machine In this test, two axles will be hooked together, force being applied in opposite directions The force applied by the Gleason machine will be measured by the Thrustorq This test will be carried to failure of the axle A 60 square inch Thrustorq capable of measuring torque from 200 to 185,000 pound-inches will be used

The second major test installation will be a new chassis dynamometer testing machine In using this machine, the car is anchored so that it cannot move, the wheels, however, turn at road speed, the resulting torque being absorbed by the dynamometer and measured on the Thrustorq

By these various new tests, say Buick engineers, we hope to develop better carburetion, better engine design, better valves, better axles and, in general, better performance

An engine dynamometer equipped with torque tester It is inclined so engines may be tested at the same angle at which they would operate in completed cars

ELECTRONIC SPECTROGRAPH

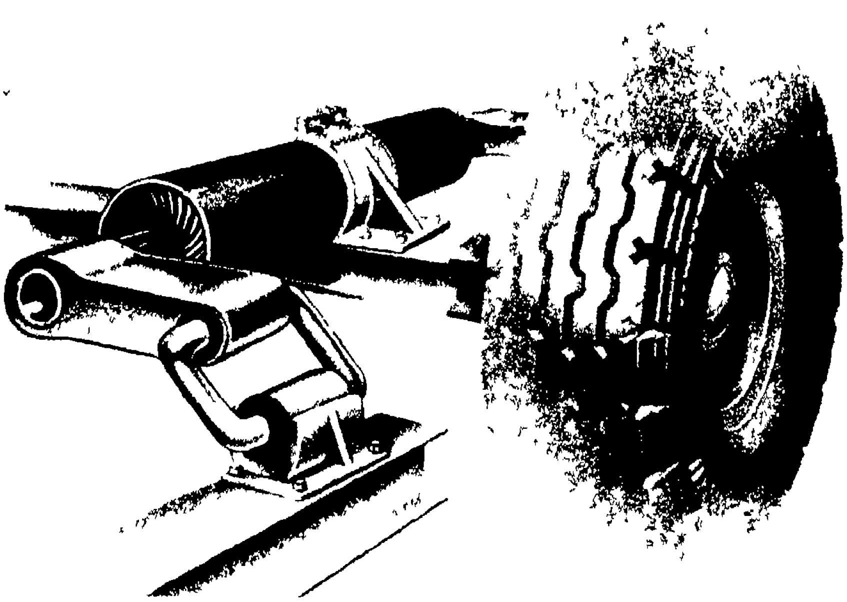
Facilitates Study of Rapid Chemical Changes

Development of a cathode-ray spectrograph, which makes a continuous analysis of rapidly changing colors and permits detailed study of the chemical changes these colors reflect, was revealed recently at a meeting of the American Institute of Electrical Engineers

The electronic instrument is expected to be valuable in jet engine and rocket research, chemical and industrial plants, radar, and television, as well as in basic scientific research

The instrument combines a spectrograph, which breaks a ray of light into a band of color for chemical analysis, and a cathode-ray tube which converts the color-band into a single wave-like line on a colored screen, with the pattern of the line indicating the nature of the original compound giving off the light

It is expected to prove useful in studying optimum combustion conditions for jet engineers, particularly when it is desired to use the instrument in the small amount of space available in airborne missiles Since the spectrograms or color bands have already been converted into electrical form by the instrument, they may be transmitted over a wire or by radio to a cathode-ray



A rubber sleeve, acting in shear between torsion bar and encasing cylinder, as shown in the simplified sketch, offers auto comfort superior to that of steel springs

screen miles away and there projected as a picture

The instrument should find wide application in the many chemical and industrial process controls where a continuous indication is required of the state of the product being tested For example, a reaction may be carried to the correct point, as shown by the spectrogram, and then automatically stopped This can be done whenever the pattern on the screen reaches a predetermined shape The indicator may, in these cases, be located in the control room of the plant, while the analyzer is in a remote location

RUBBER SPRINGS

On Motor Vehicles Will Result in Smoother Rides

Riding comfort of passengers in automobiles and buses can be improved with rubber springs and better suspension designs, it was demonstrated at a recent meeting of the Metropolitan Section, Society of Automotive Engineers

Advantages of rubber over steel springs is the softer ride it gives, said A S Krotz, of the B F Goodrich Company, and R W Brown, of the Firestone Tire and Rubber Company Rubber offers that "riding-on-air" feeling because it absorbs a great deal more energy than do steel springs so that the rubber suspension, not the passenger, takes the jolt of a bump on the road

Resiliency of rubber makes this possible It deforms under loads and then returns to its original form Being incompressible, no amount of flexing will change its form

Another reason why rubber looms as a leading spring material for tomorrow's passenger cars is the fact that it not only acts as the spring but also anchors moving parts Weight and cost of bearings and linkage—required for steel springs—are eliminated

WOOD DECAY

Can Be Controlled, Forest Pathologist Says

Possibly as much as 10 percent of the wood from all trees cut in our forests annually is used to replace wood that has decayed in service Much of this loss can be prevented according to studies made by Dr Ray R Hirt, forest pathologist of The New York State College of Forestry, Syracuse University

Because of the shortage of well-seasoned lumber, much that is poorly seasoned is now on the market and is being used in the construction of houses and other buildings Serious decay may result because of the high moisture content of this lumber, says Dr Hirt

He states that wood rot results in damage amounting to millions of dollars annually, and that this is a double economic loss because all the lumber that can possibly be cut will be needed for new construction in the next ten years to meet housing demands

Tremendous progress was made during the war in the development of fungicides for treatment of wood, rope, and fabrics used in military equipment. By forcing these fungicides under pressure into wood, lumber may be protected for many years against decay Pressure-treated wood is not yet available in quantity on the market Although painting with wood preservatives is less effective than pressure treatment, nevertheless, it gives worthwhile protection if done thoroughly Moreover, brushing preservatives on wood can be done when the timbers are being placed in service

Not all wood preservatives can be successfully covered with paint Among the newer preservatives for wood that can be painted over are those using copper and zinc naphthenate and chlorinated phenols as a base

The proper use of wood preservatives in modern construction should be regular procedure among builders and contractors, says Dr Hirt

ETHYL ALCOHOL

From Oil Proves Purer Than Brewer's Product

Basic ingredient for hangovers ethyl alcohol, now being made for industrial use from petroleum gases, is shown by chemical tests to have fewer impurities than the beverage alcohol made by fermentation The synthetic alcohol, made from waste petroleum ethylene gas, was proved by ultra-violet absorption, an extremely sensitive test, to have negligible proportions of impurities

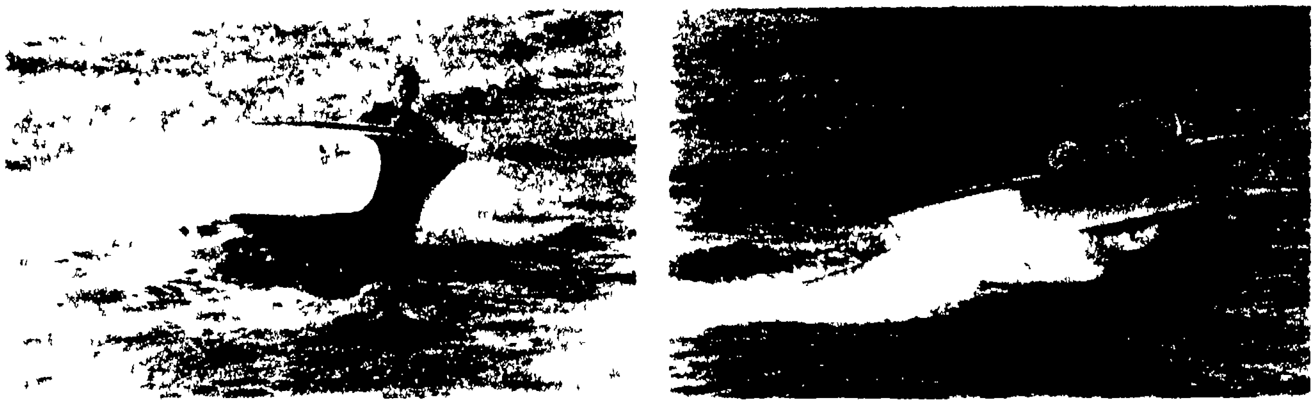
In the same report, by the Standard Oil Company of New Jersey, announcing this development, it was predicted that other sources of alcohol would be tapped in the future to meet the tremendous demand for this chemical Within the next few years it is expected that alcohol will be made from waste liquors of paper mills, sawdust, and by the Fischer-Tropsch process

COLOR DYNAMICS

Can Create Greater Comfort In Railway Cars

Emerging from the realm of experimentation into that of practical engineering, the use of color dynamics is today taking its place beside reclining chairs, broad vision windows and rubber air springs to increase the comfort of the modern railroad passenger car Light shades of yellow, green, and blue will predominate in modern passenger car designs, but to avoid monotony different tones of these colors will be used

The ceilings will be lightest, with slightly darker tones for the walls Light ceilings seem to recede from the eye, giving the impression of spaciousness, which is augmented by the darker walls, designers say, but the contrast is not enough to require any appreciable adjustments of the eyes when viewed for a longer



Made in one seamless piece, the seaworthy utility craft demonstrates its maneuverability at full speed

period of time, sharply contrasting colors produce eye fatigue

To complete the eye-level ensemble in the car, gold-tone murals or gold-tone mirrors will be placed on the walls at each end of the car blending with any of the basic car colors Dropping below the eye-level, stronger colors will be used because they help to set off furnishings, and being below the eye-level will not be gazed upon constantly

Seats will be in tones of cedar or red, floors in blues, greens, or reds matching or contrasting to the predominant color scheme used in the cars, and aisles will be in mahogany bordered with cream inlays

Through the use of color psychology it is possible to make these cars, designed by the Pullman-Standard Car Manufacturing Company, seem larger, brighter, and more restful, the designer claims, and once the passenger has selected his seat and his eyes travel to the walls and ceiling, the colors bring the comfort and cheerfulness of sunshine into the car, aiding full relaxation

FIBERGLAS BOAT

Is Light, Inexpensive, And Easily Maintained

FOR BOATING enthusiasts of moderate income, an inboard-motor utility craft is made of a combination of Fiberglas and plastics, cured in one seamless piece The boat is driven by a specially designed 26-horsepower marine engine light enough to be lifted with one hand Water tests show that it is capable of speeds in excess of a mile per hour per horsepower, and is handleable and seaworthy at maximum speeds

With a length of 16½ feet and a beam of 5½ feet, the boat will carry six adults It weighs less than 600 pounds as compared with 1800 pounds for wooden craft of similar size, and is portable on the simplest automobile trailer Its seamless construction, absence of pressure joints, and the fact that the color is embedded in the glass-plastics material make painting or caulking permanently unnecessary

Spring or fall overhauls are completely eliminated The hull is impervious to worms, the bugaboo of wood bottoms in warm waters There is no storage problem, for drying will not cause shrinkage or resulting leaks

Designed by Gar Wood Jr of the Wood Marine Engineering Company, the boat will be available in several color combinations

DECIMAL DIMENSIONING

Finds Growing Favor In Aeronautical Industry

AFFORDING major benefits of the metric system without simultaneously creating wholesale disruptive conversion headaches, decimal dimensioning is being used increasingly by the American aeronautical industry

A survey by the Aeronautical Drafting Committee of the Society of Automotive Engineers, made among airlines operators and manufacturers of planes, powerplants, propellers, and accessories, discloses that 80 percent now employs decimal dimensioning or contemplates its early adoption Users explain that the practice of expressing limited measurements in decimals rather than fractions of inches contributes to speed and to accuracy both in design and in manufacture Decimals are carried to two, three, or more places to satisfy varying tolerance requirements

The survey reveals that 76 percent of the aeronautical industry has considered the use of decimal dimensioning, that 63 percent uses it already, and that 37 percent is using it for some purposes In the propeller branch of the industry, 80 percent of manufacturers uses the decimal dimensioning system exclusively

The practice is characterized as making the dimensioning of drawings much easier and more rapid, and as being especially helpful in eliminating the time-consuming, error-producing operations of converting decimals to fractions and back to decimals again Furthermore, tolerances may be indicated merely by extending digits after the decimal point

RESONATING NUCLEI

Reveal Their Chemical Composition In a Magnetic Field

THE FEASIBILITY of using the frequency and magnetic reaction of atom nuclei in quantitative and qualitative analysis is being probed by Dr Felix Bloch at Stanford University Based on the principle that the atom nucleus of every element has a characteristic, precise frequency to which it resonates under the influence of radio-frequency current in a given magnetic field, the experiments consist of enclosing the test materials in tiny glass vials and placing them in the field of a powerful electro-magnet Then the radio-frequency current is induced into the nuclei, making them spin very much like a gyroscope A sensitive receiving set determines, when the nuclei are spinning at a rate of approximately 42,500,000 revolutions per second at right angles to the field, the frequency given off by the nuclei And it is this frequency at which the nuclei resonate which gives the key to the composition

At present, Dr Bloch explained, his experiments have centered on testing hydrogen nuclei, which, although light, have a high nuclear magnetism. These tests have proved effective and signals strong enough to be recorded have been secured when the protons existed either in solution or in paraffin

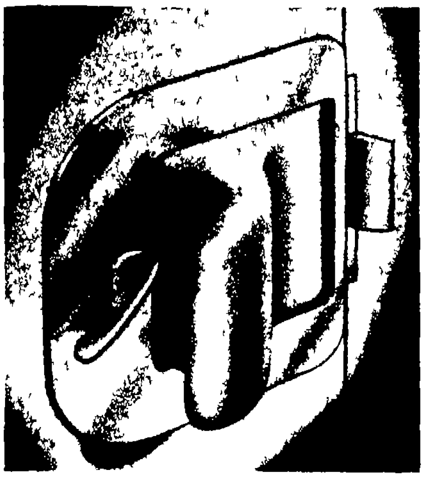
Cautious in predicting the practical applications of this method of analysis, Dr Bloch states that "the system at this stage isn't foolproof and 100 percent accurate as yet, as it must be in order to be of practical, scientific value in qualitative and quantitative analysis"

New Products and Processes

PUSH-PULL LATCH

Fits Standard Doors, Is Easily Opened

Representing a departure from conventional design, a door latch which is simply pushed to open doors swinging outward, or pulled to open doors swinging inward, offers new convenience and safety In case of emergency pressure from the elbow, knee, or body will open the latch, because the working parts of the latch are precision-formed, only light pressure is required Manufactured by Parlyn, Ltd, it is easily installed in standard-size doors The unit is fitted into a saw-cut 2½ by 2¼ inches, and is then made secure by turning two bolts which expand the latch in the cut Slight inaccuracies in the cut will not affect operation Latches are available in a wide variety of finishes, and in three styles without lock with trip lock, and with cylinder lock


Door latch installation is simple

MIDGET DRY BATTERY

Provides Light-Weight Source of High Potential

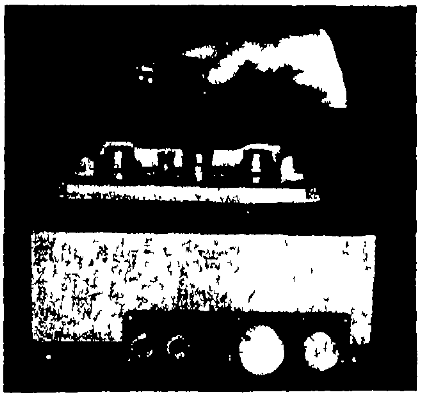
Designed as the high-voltage source for a compact, portable, and completely self-contained radioactivity meter miniature 300-volt dry batteries weigh only one pound apiece With dimensions of 2-11/16 by 2-11/32 by 3-15/16 inches, these high-potential, low-drain batteries, known as Eveready Number 493, have a life expectancy of as high as 350 hours, and are the product of the National Carbon Company

In addition to supplying the high-potential for portable radioactivity meters, known as Geiger counters, these batteries will find application in a variety of other fields In commercial and press photography, for example, a set of six of these batteries will provide sufficient energy for as many as 2500 flashes in multiple flash tubes of the gas discharge type They should prove valuable also in photo multiplier tubes for the measurement of small quantities of light Other possible applications include a voltage source for small, lightweight insulation testers, excitation voltage supply in portable television pick-up devices, bias supply in high-gain direct current amplifiers, or in any circuit requiring a high potential where drains are measured in microamperes

WIRE DICTATING MACHINE

Has High-Speed Rewind To Facilitate Corrections

Specifically designed and built as a dictating machine for general business use, a magnetic-wire recorder, complete in one unit, combines both recorder and play-back The voice of the speaker is recorded on a strand of stainless steel wire moving between two spools The same wire passing through the magnetic field with the control switched to the "listen" position reproduces the voice with all the clarity of the original The spool of wire may be stored away and reproduced years later with no impairment of reproduction, or it may be reused by simply recording over the original message


Receptacle into which magazine fits

To load, a magazine containing spools of wire is set in place on top of unit

One of the features of this machine, called Sound-On-Wire, is forward and rewind speeds of 20 feet per second, ten times faster than the recording speed This added speed facilitates the whole dictating operation by cutting down the time spent in going back in the message to make "erasures" When a correction is desired, the wire is reeled back at this accelerated speed and the operator simply re-dictates No intermediate step is required, as the wire is automatically cleared when it passes through a demagnetizer coil before reaching the recording head

The magazine holding the wire is self-contained and can be transferred from one machine to another for playback or recording The controls are so simplified that no instructions are required to operate it

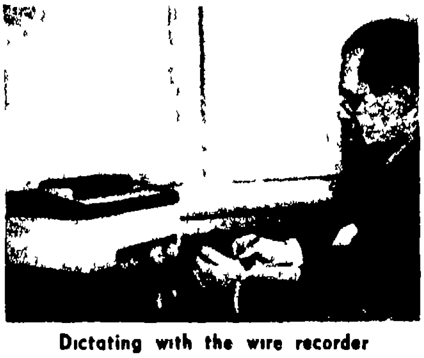
With the use of a small earphone about the size of a modern hearing-aid ear piece, the transcribing operator can adjust the volume so that the reproduced sound cannot be heard by others in the room A convenient pedal-type control enables the operator to start and stop playback by applying light foot pressure

In addition to general office service, Sound-On-Wire, a product of the Standard Business Machine Company, is adapted to many special uses such as recording radio programs, business meetings, and telephone conversations

CORRUGATED PLASTICS

Add Beauty and Strength To Structural Applications

Industrial and architectural designers in decorative and structural fields will find new applications for transparent


Dictating with the wire recorder

The transcribing operator can use the comfortable, light weight earphone

acrylic plastics in corrugated sheets In this form, Plexiglas combines the decorative advantages of a transparent corrugated material with the safety, flexibility, and ease of handling found in the usual flat acrylic plastics A thin sheet of the plastics is made rigid by corrugating and can therefore be used where a much thicker sheet of the flat material would tend to sag or bend In trains and buses, for example, baggage racks made of 080 inch thick plastics are able to withstand the impact of 25 pound lead weights and to support these weights without visible deflection Also corrugation reduces the area exposed to surface abrasion and effectively diffuses any scratches which do occur

For lighting shields, free standing screens, inner partitions in home or office, diffusing windows and display fixtures, corruguated Plexiglas is described as not only displaying superior structural advantages but adding a lustrous modern note of beauty as well

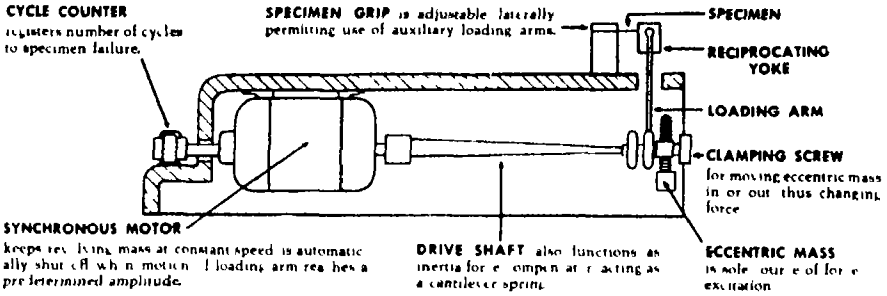
FATIGUE TESTER

Needs No Attention During Operation

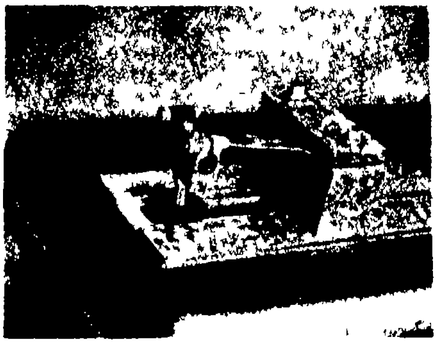
Filling the demand for a bench-type fatigue testing machine with the "constant-force" loading feature, a new machine affords flexure fatigue tests on sheet stock of any material—metal, plastics, wood—and requires no attention during the test The unique design eliminates the need for any electronic equipment, complex linkage, or special device to maintain a constant force while the specimen is under test

This testing device uses a revolving eccentric mass as a means of loading the specimen, avoiding cams or eccentric connecting rods which require readjustment during the test as the stiffness of the specimen changes With this constant force machine, the load automatically remains constant regardless of the changes in the amount of deflection of the specimen A predetermined load is alternately applied to the specimen, and the resulting deflection is incidental

The value of dynamic testing with this machine developed by The Baldwin Locomotive Works, as compared with any static test, is obvious The specimen undergoes the same stresses the material would sustain in actual use and the point of failure is accurately determined Because of its comparatively small size, 15 by 12 by 32 inches, the fatigue testing machine can be placed in a cabinet during a test so that temperature and humidity can be controlled The machine weighs 115 pounds, has an alternating force capacity of 20 pounds and a speed of 1800 cycles per minute


CYCLE COUNTER registers number of cycles to specimen failure.
SPECIMEN GRIP is adjustable laterally permitting use of auxiliary loading arms.
SPECIMEN
RECIPROCATING YOKE
LOADING ARM
CLAMPING SCREW for moving eccentric mass in or out thus changing force
SYNCHRONOUS MOTOR keeps revolving mass at constant speed is automatically shut off when motion of loading arm reaches a predetermined amplitude.
DRIVE SHAFT also functions as inertia for compensator acting as a cantilever spring
ECCENTRIC MASS is sole source of force excitation

Simplified diagramatic drawing of the fatigue tester



Testing to the point of fatigue failure, the machine will impose a bending moment of 60 inch-pounds on the tapered specimen (left) The five-inch auxiliary loading arm (at the right) affords a maximum bending moment of 100 inch pounds

MELAMINE TABLEWARE

Resists Breakage In Roughest Service

Heavy-duty plastics tableware has been designed especially for use by restaurants, institutions, cafeterias, hospitals, and hotels, with ease of handling and conservation of space in mind All pieces stack, plates and cups are suspended on molded-in flanges and do not rest directly on one another Consequently, there are no unsightly rings and sanitary air drying is made possible Constructed of the American Cyanamid Company's Melmac plastics, the tableware withstands boiling and can be cleaned in automatic dishwashing machines Because of the shock-resistant characteristics of the melamine plastics, dishes resist breakage, even when submitted to the most severe restaurant or cafeteria service The plastics is odorless, tasteless, and highly resistant to attack by fruit juices or other foods

All units are supplied in a range of standard colors—blue, cream, green, light tan, red, and yellow

SILENT RIVETER

Hydraulically Operated, Flattens Rivets with Single Blow

Used primarily in manufacturing plants where work can be brought up close to the machine, a silent riveter looks like a huge C-clamp, and slips over the parts to be joined, holding the head of the rivet in place while the other end is flattened with the tremendous pressure of a single stroke Hydraulic pressure of several thousand pounds per square inch is transmitted from the generating equipment to the riveter by means of an oil-resistant wire-reinforced synthetic rubber hose manufactured by the United States Rubber Company

Noiseless riveter in operation

AUTO REFINISHING

Takes Only Five Hours On Production Basis

Making it possible for the automobile owner to have his car repainted in any one of 3700 original factory finishes in less than five hours, a high-speed, low-cost auto refinishing process uses a low bake enamel which was developed by the Sewall Paint and Varnish Division of the American-Marietta Company The paint has special oxidizing characteristics which permit the finish to dry completely within 45 minutes Temperatures in the bake oven range from 165 to 180 degrees, Fahrenheit causing a curing action in the enamel as soon as the car is removed from the oven and cooled, it is ready for service

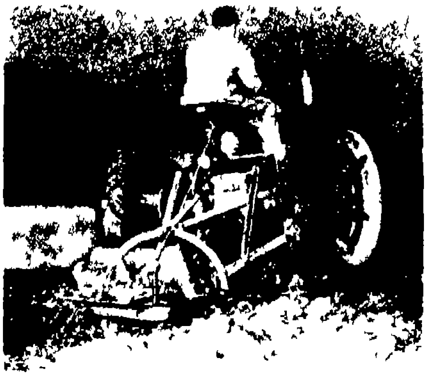
Refinishing can be done on an assembly line basis, each of eight operations requiring at least 20 feet of floor space After the metal work is repaired and sanded, the car is washed and cleaned of all dirt and grease, windows and chrome are masked, and the car is primed with a coat of special lacquer.

The car is then ready for water sanding, making use of fine abrasive paper. After the car has been carefully inspected to be sure that all masking tape is securely in place and that all imperfections have been filled and sanded, the entire surface is carefully blown off by high-pressure air to remove all traces of dust and moisture. It is then ready for the paint booth where two operators with high pressure spray guns, working at opposite sides of the car, apply the desired color. Ventilation in the booth is supplied by two blowers, each equipped with filters to keep the booth absolutely dust-free. Doors from the spray booth open directly into the ovens where the car is baked.

TRACTOR SCOOP

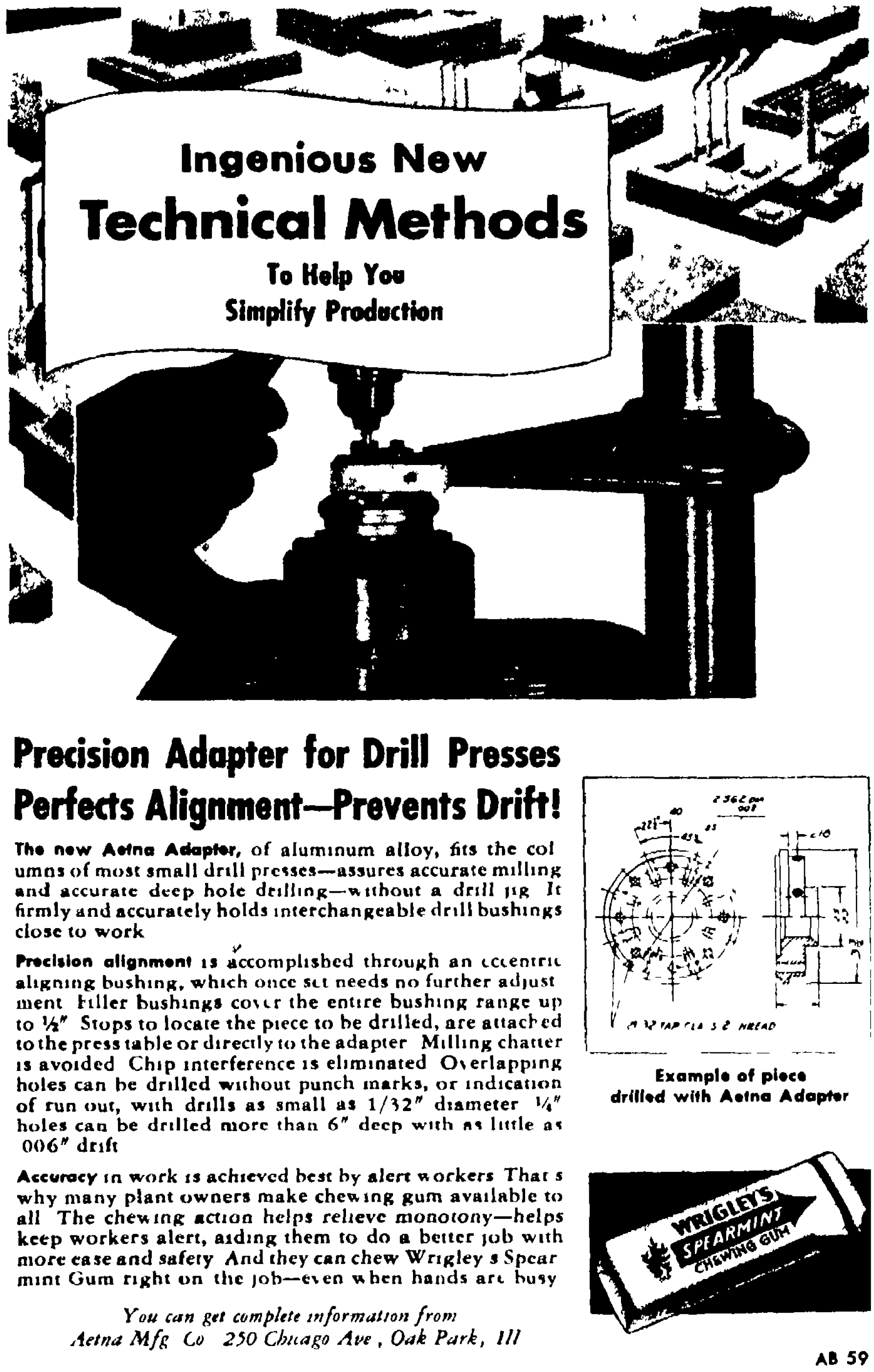
Easily Attached,
Operates Hydraulically

ATTACHABLE to most hydraulic-lift tractors, an earth-moving scoop that can be mounted in less than five minutes is simple to operate, easy to maneuver in tight places, and sturdily built for hard use. In less than 15 seconds it will scoop up a load of ten cubic feet of dirt. Under reasonably favorable conditions it is possible to excavate a basement 20 feet by 30 feet by 6 feet deep in less than a day with this scoop.


Takes less than five minutes to attach

Digging ponds and ditches, repairing washouts, landscaping, leveling, and similar tasks can be done with equal ease.

This hydro-scoop manufactured by the Stockland Road Machinery Company, mounts on the rear of the tractor, rather than being pulled behind it. The scoop is raised or lowered by the tractor's hydraulic lift unit, and can be tripped or dumped with an easy, one-hand movement, while the tractor is moving.


Ingenious New Technical Methods To Help You Simplify Production

Precision Adapter for Drill Presses Perfects Alignment—Prevents Drift!

The new Aetna Adapter, of aluminum alloy, fits the columns of most small drill presses—assures accurate milling and accurate deep hole drilling—without a drill jig. It firmly and accurately holds interchangeable drill bushings close to work.

Precision alignment is accomplished through an eccentric aligning bushing, which once set needs no further adjustment. Filler bushings cover the entire bushing range up to ½". Stops to locate the piece to be drilled, are attached to the press table or directly to the adapter. Milling chatter is avoided. Chip interference is eliminated. Overlapping holes can be drilled without punch marks, or indication of run out, with drills as small as 1/32" diameter. ¼" holes can be drilled more than 6" deep with as little as .006" drift.

Example of piece drilled with Aetna Adapter

Accuracy in work is achieved best by alert workers. That's why many plant owners make chewing gum available to all. The chewing action helps relieve monotony—helps keep workers alert, aiding them to do a better job with more ease and safety. And they can chew Wrigley's Spearmint Gum right on the job—even when hands are busy.

You can get complete information from
Aetna Mfg Co 250 Chicago Ave, Oak Park, Ill

AB 59

STABILIZER AND LUBRICANT

Can Also Serve
for Waterproofing

DIBASIC lead salt of stearic acid, a soft, pure white, unctuous powder with all the apparent lubricity of normal lead stearate, is insoluble in water and in most of the common organic solvents. It reacts with warm turpentine forming a waxy compound with an approximate 5 percent solubility therein. This compound is in turn soluble in mineral spirits which suggests its use as a protective coating for unpainted metal, in the waterproofing of fabrics, and so on. It is soluble in some plasticizers. Its basic lead content, its low refractive index, and its solubility in these plasticizers make it an excellent plasticizer for some types of clear vinyl plastics.

When so used, the dibasic salt has two-way utility, being an excellent heat and light stabilizer. It has some degree of solubility in tricresylphosphate and several other plasticizers. Moreover it is very soluble in mixtures of either tricresylphosphate or dioctylphthalate and some of the aromatic petroleum type plasticizers. It produces clear amber films when the aromatic petroleum type plasticizer is used to the extent of 50 percent or more, or comprises the total plasticizer content. Called DS 207, it is also an effective lubricant—an excellent replacement for the lubricants commonly employed with vinyl compounds to improve flow characteristics for molding, extruding, and related processes.

DS 207 makes superior leaded greases when mixed with lubricating oils. The greases are excellent protectives against corrosion, due to the basic characteristics of the dibasic lead stearate. DS 207 greases are uniform in composition which insures positive protection against wear of the machine parts to which they are applied.

The compound, produced by the National Lead Company, has possibilities as a constituent of cutting oils. Other potential uses suggested by its composition are as a drier in some types of paint, and as an additive to improve the brushing characteristics of oil paints

GRINDING ATTACHMENT

Can Be Adapted To
Most Machine Tools

For use on lathes and other machine tools, an electric grinding attachment is designed primarily for precision external grinding, and is equipped with a four by one-half inch grinding wheel which is driven by a constant speed continuous duty one-quarter horsepower motor This permits taking heavier sustained cuts than would be practical with a universal type motor of the same rated horsepower Available with frame sizes to fit various sizes of lathes, this grinding attachment can easily be adapted to milling machines, shapers, planers, and so on

The grinding wheel spindle runs on pre-lubricated sealed precision ball bearings which require no adjustment or additional lubrication Effectively protected from abrasive grinding wheel dust, the bearings will retain their precision indefinitely Tension adjustment is provided for the V-belt which connects the motor with the grinding wheel spindle, and both the grinding wheel and the V-belt are enclosed in a single guard

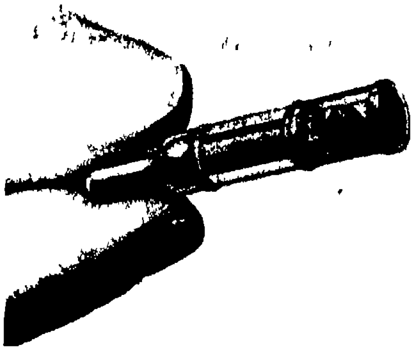
Wheels available for various materials

Spring stops for grinding straight and spiral fluted reamers and cutters, diamond dressers for truing the grinding wheel, and holding fixtures for the dressers can be furnished for use with this grinding attachment, a product of South Bend Lathe Works Wheels are available in several grades for grinding various materials, including tungsten carbide, tool steel, machine steel, cast iron, brass or bronze, aluminum, Bakelite, hard rubber, and soft rubber Special cup wheels are supplied for reamer and cutter grinding

CAPSULE-SIZE PHOTOTUBE

Permits More Compact
Photoelectric Devices

Smallest ever offered commercially, a new phototube about the size of a .22-caliber long rifle cartridge, has a maximum diameter of only 1/4 inch and an overall length just under 1-13/32 inch and is activated by light entering through a tiny window at its larger end. Comparing favorably with larger phototubes in sensitivity, the tiny new tube, produced by the Radio Corporation of America, is expected to find many applications in business and industry, particularly in devices and machines where the size of former phototubes has been a problem



Activated by light through end window

In multiple-circuit control devices, the new tube makes possible either smaller devices or more circuits in the same space In animated signs, for example, where each phototube is individually wired to a light in the corresponding position on the signboard, many more of the 1P42 tubes, as the new tube is called may be used in a given area When light, projected through slides or film, falls on and activates the more closely spaced tubes, sharper and clearer pictures can be reproduced on the lighted signboard

NON-ARCING GLUE

Eliminates Burns
In Dielectric Curing

Phenolic glue, especially formulated to be non-conductive in a high-frequency field, will not arc when a squeeze-out of the resin forms contact with an electrode in a radio-frequency dielectric heating installation, nor when the electrodes are brought into contact with the glue line, thus eliminating one of the chief disadvantages of dielectric glue curing

Known as Cascophen RF-228, this product of the Casein Company of America allows the use of maximum power, speeding the curing process It is supplied in liquid form with a separate powder catalyst The set film pH is substantially neutral and forms a durable, waterproof, fungusproof, and boilproof bond The liquid resin is stable in storage for 10 to 12 months at 70 degrees, Fahrenheit, in tightly closed containers The resin is an alcohol-water solution, and is not harmed by freezing The catalyst is stable in storage, but should be kept in an airtight container, away from heat

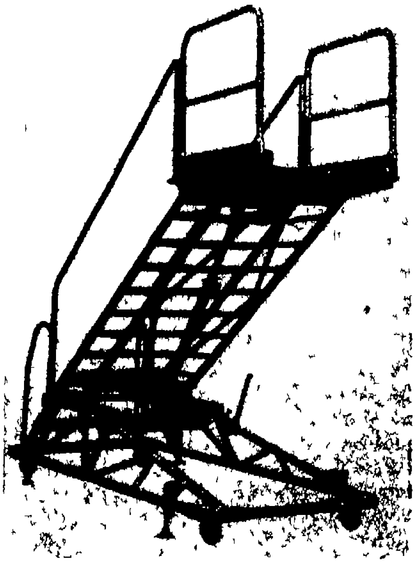
Dielectric glue avoids such burns

ADJUSTABLE PLATFORMS

Replace Scaffolds
In Many Operations

Hydraulically operated adjustable work stands, originally designed for the elimination of costly, cumbersome scaffolding and special workstands for war-time aircraft maintenance, are now available for general industrial use A 16-square-foot work platform, with a maximum static load capacity of 1500 pounds, is hydraulically elevated or lowered to any working level from 3 to 24 feet, according to the individual model The units feature the exclusive and patented use of automatic and self-adjusting steps which maintain their position parallel to the ground regardless of the working angle of this stand produced by Airquipment Company

Scaffolding strips, stand extensions, and hoist attachments further enhance the general utility features of the stands, called Aerostands, and all models are equipped with guard rails and skidproof surfaces on platforms and steps Frames are constructed of welded tubular steel mounted on swivel casters with caster locks Truck locks are provided to hold stands stationary when in service Tow bars, scaffold strips, stand extensions, and hoist attachments are optional equipment



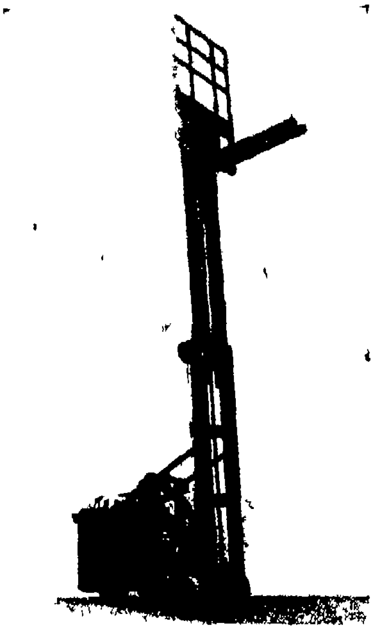
Maximum load is 1500 pounds

FORK TRUCK

Will Lift 3000 Pounds
To a Height of 18 Feet

Having an elevating reach of 18 feet above floor level, a novel fork-type industrial power truck has new features of design and construction which make it especially useful for high-tiering materials and merchandise It is unusually compact, with increased speed and flexibility for maneuvering, and lifting and lowering loads The truck picks up loads on its bare fork or on pallets in the same manner as with standard models Its capacity is rated at 4000 pounds for lifting to a height of 11 feet, and 3000 pounds to 18 feet It is electrically driven, with three separate motors, one for traveling, one for operating the elevating mechanism, and the third for tilting the upright columns Tilting limit is 15 degrees backward and five degrees forward from vertical

Lifting speed with capacity load is 13 feet per minute, lowering speed 20 feet per minute, truck's traveling speed five miles an hour


Speedy compact, and maneuverable

Body of the Elwell-Parker truck, independent of the uprights and fork, is only seven feet eight inches long Overall width is three feet two inches, enabling it to maneuver in narrow aisles

One pair of columns, 11 feet above the floor level forms a primary frame the bottom of which is pivoted at the forward base of the truck body A second pair of columns, virtually the same length as the primary, forms the telescoping frame The secondary frame operates on ball-bearing rollers in alloy steel tracks which form part of the primary frame The secondary frame is not actuated below heights of 11 feet, in fact, its presence is not apparent until the fork is lifted beyond that height

FIREPROOF SHEETING

Conserves Fuel, Is Easily Installed

Sheet-steel fire-arresting insulation, only 006 inch thick, has been proved to withstand temperatures up to 1000 degrees, Fahrenheit Easily installed in any building, the sheet insulation is also completely resistant to vermin and termites Because it reflects 95 percent of all radiated heat, installation of this material, known as Ferro-Therm, cuts fuel costs as much as 30 percent and, during summer, reduces inside temperatures as much as 10 degrees This fireproofing, produced by the American Flange and Manufacturing Company, is available in sheets 24 by 32 inches, a carpenter can install an average of 800 square feet per day

NON-WOVEN FABRICS

Of Rayon Staple Are Strong and Easily Colored

A development in the use of viscose rayon staple is making possible the manufacture of several different types of non-woven fabrics Among the industrial forms are ribbons tapes, filters, lens wiping tissue, bindings and interlinings, insulation covering tags and special wrappers, containers, and bags In the household they are found as wall coverings, curtains, drapes, napkins and table cloths, towels, and wiping cloths

Non-woven fabrics are essentially multiple webs of rayon or other fibers in which the fibers are bonded together by various means Prominent among the methods of accomplishing the bond is by blending potentially adhesive fibers, such as Vinyon or plasticized cellulose acetate, with non-adhesive fibers, like cotton, wool, or rayon in the formation of the web, and subsequently activating the adhesive fiber by means of heat and pressure to lock the fibers in place and strengthen the fabric By varying the relative fiber content, weight of web, and bonding conditions, many interesting, novel, and desirable changes in hand and

SENSATIONAL WAR BARGAINS
in LENSES and PRISMS

ASSEMBLE YOUR OWN BINOCULARS
Complete Optics! Complete Metal Parts!
(Delivery on Binocular Sets Beginning January 30th)
Save More Than ½ Regular Cost

ARMY S 7 x 50 BINOCULARS Here s an unusual opportunity to secure a fine set of Binoculars at a substantial saving of money Offered here are complete sets of Optics and Metal Parts for the Army s M-16 7 x 50 Binoculars (M-16 is not the waterproof model) These components are new and all ready for assembly We supply full instructions Limit—1 set of Metal Parts and 1 set of Optics to a customer

METAL PARTS—Set includes all Metal Parts — completely finished — for assembly of 7 x 50 Binoculars No machining required Bodies have been factory hinged and covered A sturdy brown leather Binocular Carrying Case is included with each set of Metal Parts
Stock #824 S 7 x 50 Metal Parts $35 00 Postpaid

OPTICS—Set includes all Lenses and Prisms you need for assembling 7 x 50 Binoculars These Optics are in excellent condition perfect or near perfect — and have new low reflection coating
Stock #5102 S 7 x 50 Optics $25 00 Postpaid

NOTICE! If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20% Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled

ARMY S 6 x 30 BINOCULARS

No Carrying Case with any Sets shown below (None yet available in Surplus Market) M 13A1 sets are waterproof model M-3 sets are not waterproof Limit — 1 set to a Customer on all Sets shown below

COMPLETE OPTICS & METAL PARTS — Model M 13A1 6 x 30 Binoculars Everything you need—ready for assembly When finished will look like a regular factory job costing $102 to $120 The Optics are new in perfect or near perfect condition Have new low reflection coating Metal Parts are new and perfect all completely finished No machining required Bodies factory hinged and covered. Complete assembly instructions included
Stock #830-S $40 00 Postpaid
plus $8 00 tax — Total — $48 00

COMPLETE OPTICS & METAL PARTS — Model M 3 6 x 30 Binoculars. The Optics in this set are new perfect or near-perfect Prisms have new low reflection coating Factory mounted Eye Piece and Objective Assemblies not coated Metal Parts are perfect new ready for assembly When finished, this will look like a regular factory job except a name has been filed off a cover plate No machining required Bodies factory hinged and covered
Stock #831 S $35 00 Postpaid
plus $7 00 tax — Total — $42 00

METAL PARTS ONLY — Model M 13A1 6 x 30 Binoculars No Optics Same Metal Parts as described for Stock #830-S
Stock #832-S 6 x 30 Metal Parts $25 00 Postpaid

METAL PARTS ONLY — Model M 3 6 x 30 Binoculars. No Optics Some machining on these Metal Parts required Bodies hinged and Prism Shelf holes placed but you must tap them Prism Shelves have been machined Six lead spiral focusing threads have been cut Some less difficult components you must thread and machine yourself, but all material you need is furnished except body covering material and Optics
Stock #833-S 6 x 30 Metal Parts $12 00 Postpaid

TO KEEP POSTED on all our new Optical Items send 10¢ and your name and address to get on our regular Flash' mailing list

ARMY S 6 x 30 BINOCULARS (Cont d)

OPTICS FOR 6 x 30 BINOCULARS (No Metal Parts) Slight seconds Cemented but not coated
Stock #5123 S $10 00 Postpaid

SAME OPTICS AS Stock #5123 S (6 x 30) but coated
Stock #5124 S $12 75 Postpaid

If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20% Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled Optics and Metal Parts are Available for Monoculars (½ a Binocular) For Complete Details Write for Bulletin #14 S

AIR FORCES GUN SIGHT—With Polarizing Variable Density Attachment (Polarizing attachment *alone is worth many times the price of entire unit*)
Stock #908 S $5 00 Postpaid
Same Unit Without Polarizing Attachment
Stock #916 S $2 50 Postpaid

SCHMIDT OPTICAL SYSTEM Black plastic body size 3-15/16" by 5½" F L 2 4" with amazing speed of F O 9 Used in Navy s Infra-Red Sniperscope and Signalling Units Govt cost $134 Limit —1 to a customer
Stock #720 S $6 00 Postpaid

MOUNTED PROJECTING LENS SYSTEM F L 91 44 mm (just right for 35 mm Projectors) Speed of F 1 9 Outside dia of mount at one end 60 mm Length of mount 64 mm
Stock #4033 S $3 00 Postpaid

MOUNT FOR ABOVE PROJECTING LENS SYSTEM
Stock #715 S $1 50 Postpaid

BATTERY COMMANDER S PERISCOPE With Tripod — 6 Power Instrument Excellent condition Length 27½ inches—diam 1½ inches Cost U S Govt approximately $175 00
Stock #717 S $20 00 F O B Audubon

RAW OPTICAL GLASS—An exceptional opportunity to secure a large variety of optical pieces both Crown and Flint glass (seconds) in varying stages of processing Many prism blanks
Stock #703 S 8 lbs *(Minimum weight)* $5 00 Postpaid
Stock #702 S 1½ lbs $1 00 Postpaid

2⅛" DIA ACHROMATIC TELESCOPE OBJECTIVE—F L 20 inches (Not a war surplus item) The *Govt used very few long focus* Objective Lenses so we had these made for you First class lens suitable for Spotting Scopes Terrestrial Telescopes etc Not coated
Stock #6197 S $10 00 Postpaid

BOMBER SIGHTING STATION — A double end Periscope Type Instrument of highest precision 6 ft tall shipping wt 360 lbs Orig cost $9 850 Consists of numerous Lenses Prisms Mirrors Gears Motors Metal Parts and Electrical Gadgets
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texture may be obtained "to order

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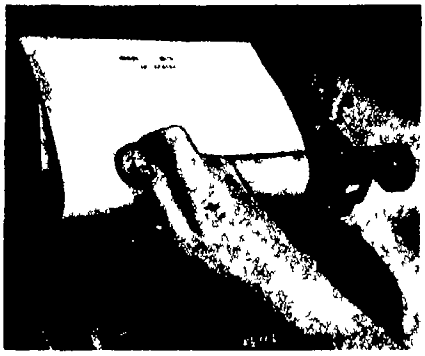
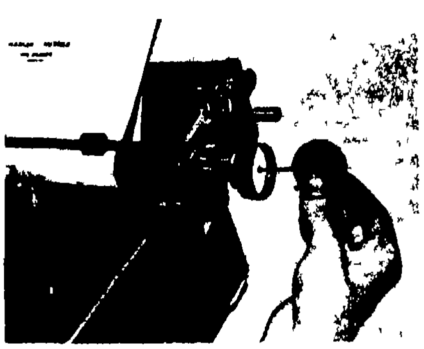


Typewriter eraser in use



Fits into recess in platen knob

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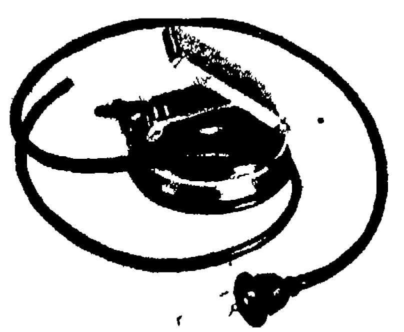

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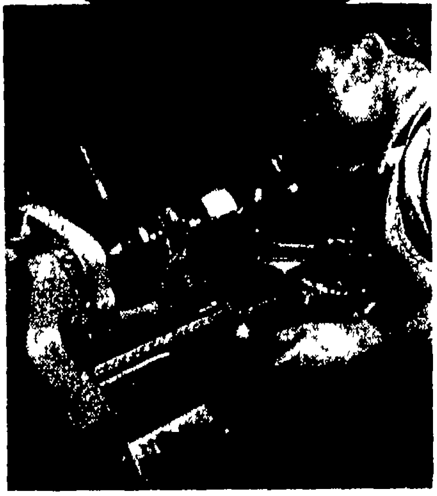

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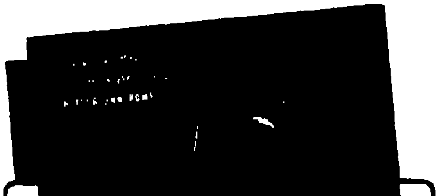

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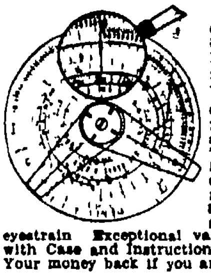

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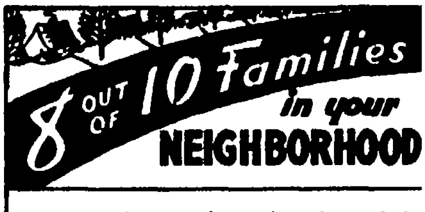

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Averaging once a year someone asks this department why telescope mirrors have to be so thick, and now comes an inquirer who reasons that if mirrors were thinner they would have just that much less weight to support and therefore wouldn't sag any more than thicker ones, also would adapt themselves to temperature changes more quickly

This sent us to a remembered file of papers containing an article in the *Journal of the Royal Astronomical Society of Canada*, July-August 1935, in which Harold C King, Calgary, Alberta, similarly contested the statement in "A T M," page 75, that mirror disks should have thicknesses not less than one eighth of their diameters, one sixth still better, and which was never rebutted "Some dicta," he stated, "are proved to be wrong by their supposed explanations If there is anything illogical in the explanation there is probably something wrong with the whole proposition Consider, for example, the dictum that the mirror of a reflecting telescope must be made of glass which has a thickness of at least one eighth of its diameter, and is said to be better still if it is as thick as one sixth of its diameter The reason given for this thickness, in the book 'Amateur Telescope Making,' is that if the mirror is made of glass having a less thickness in proportion to diameter than one eighth, it will not keep its figure That is, it will warp, the reason for the warping being that 'it will bend of its own weight' Even supposing it to be true that thin mirrors are found to warp," he then continued, "the explanation that this is caused by its own weight is illogical on the face of it It should be obvious that if the mirror is thin there is therefore less weight to warp it"

And so he made a thin mirror, ½" by 9½", or a ratio of 1 19, and it gave excellent star images and suffered not the slightest change in figure—which does not, however, prove anything

If the premise on which the above-described argument is based is sound logic, then we may continue on past the 1 19 ratio If it is good for 1 19 why isn't it good for 1 29 or 1 39? Or 1 99? Why stop even there? Why not toss out the glass altogether and let the aluminum coating stand up alone? In this series of stages has any new principle entered in at any point? We see none

This, therefore, is disproof by *reductio ad absurdum*, but just why does the thick mirror stand up and the thin one, weighing proportionately less, fall down? For answer, we need only look at an engineering treatise, in the section on strength of materials Consider the mirror in two extreme positions—first, flat on its back, then on edge Taking the first case, a cross-section of the mirror has its analog in a common floor beam having uniform loading, in this case the weight of the mirror disk itself Various factors enter in and the analysis could be made complicated but there is no need of it No need, either, to cite a flock of formulas In Trautwine's "Engineer's Pocketbook" is the simple statement of principle that the strengths of beams having similar cross-sections are inversely proportional to their spans and directly proportional to their breadths *and to the squares of their depths*

Figure 2 Channeled tool

Now take the alternative case of the mirror when tipped up on edge It is now a column and here the general relation involved is a proportion between the square of the height and the square of the width Again the square

This, then, is the plain answer—in principle, for circumstances sometimes will modify it in specific cases

How, then, did the Calgary critic's 1 19 mirror get by? Probably because the 1 6 or even the 1 8 ratio contains a very large, healthy factor of safety and, many think, wisely so, just as is the case in most engineering structures wherever such is possible And his 1 19 luckily lay within it—in this particular instance It might always, or even often Maybe three out of four, or even nine out of ten, mirrors would get by with a ratio of, say, 1 12 Maybe thereafter the tides would set in strongly against luck. These figures are based on no definite experimental data and are simply guesses.

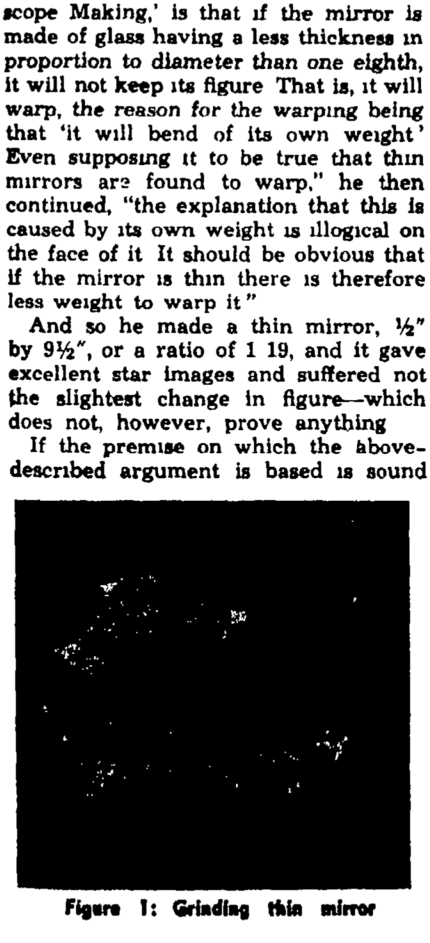
Figure 1: Grinding thin mirror

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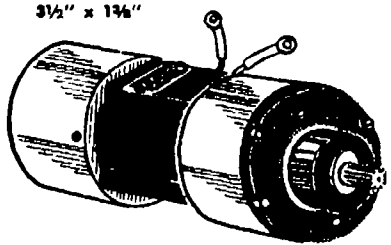

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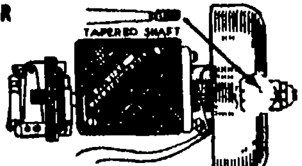

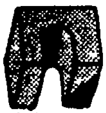

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The 1 19 that got by was probably pretty close to the edge of the cliff It is fun to live dangerously Therefore, try 'em as thin as you like—at your risk But glass is cheaper than sweat and tears

Commenting on the above comments, which were shown to him, R W Porter mentioned an experiment described in *Comtes rendus*, Vol 186 (1928) page 311, by Professor André Couder of the Paris Observatory, a co-author of that excellent work "Lunettes et Télescopes," ("Refractors and Reflectors"), by Danjon et Couder, published 1935 "He took a Pyrex dish," Porter writes, "which was 7½" in diameter and about 2" high, with walls only ½" thick, and parabolized the bottom of the dish He then took it from a warm room out into the cold night and inserted it in his Newtonian telescope, and could see no change in definition with temperature change of 36° F This," Porter adds, "would be a good stunt for the amateurs to try out A bar, if supported at its ends, sags twice as much as if the ends were clamped to some rigid body and that condition obtains in the experiment just described" Maybe because of this last this was not an extreme kind of experiment

The 200" mirror has a thickness of 24", hence its ratio is approximately 1 8 Even then, it has an elaborate flotation system Yet, from the single point of view of rapid temperature equalization the 200" has a thickness-diameter ratio of 1 40^1 Its face is only 5" thick and no part of the honeycomb rib structure that supports that face (and is cast integral with it) is farther than 2½" from the surrounding air This is a true triumph

AFTER the above was prepared, the following cognate discussion of a mirror of thin ratio 1 13 8 came from C S Walton 5975 W 44th Ave, Wheatridge, Colorado, (one of the former Roof Prism Gang of wartime ATMs, he with neighbor Anton Bohm, made 500 prisms of two-second roof-angle tolerance)

'In June, 1941" he says, "Anton Bohm and the writer got the idea of trying to make a large mirror of glass much thinner than is usually prescribed We got a piece of 1¼" plate glass cut out a 17¼' disk with a biscuit cutter and completed a mirror which is at last mounted In the intervening years after final figuring numerous Foucault zonal, and Ronchi tests were made and no change from the original figure was detected Now mounted, the mirror has good definition and no noticeable astigmatism"

Walton continues "Mr R E Glover, supplied some mathematical data and remarks on thin-mirror practicability 'If this disk,' he stated, 'were supported in a horizontal plane by a rim under the outer edge, its own weight of 23 3 pounds would deflect the center of the disk 0 000,025,3" downward It is estimated that, if the disk were pressed against the polishing lap with a force of 20 pounds, transmitted to it through a handle 4" in diameter such as was used (Figure 1), the deflection would

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be 0 000,023,4", based on the assumption that the pressures were applied uniformly by handle and lap Both of these deflexions are large enough to have an effect on the corrections, since they equal about one fifth of the modification necessary to parabolize the mirror They are small enough so that, with care in the design of the mirror support and, before that, of the polishing handle, they should permit a disk of these dimensions to be used successfully '

"The handle we therefore devised," Walton continues "adhered to the mirror at six points located on the 70 percent zone—that is, at two pitched on points on each of the three pieces shown in Figure 1 The mirror was worked face down and the illustration shows it on its lap atop an oil drum

'Tony Bohm and I were after quick results so he did the roughing out with his sandblasting equipment [Runs a gravestone works—*Adv*—*Ed*] and then an old coarse-grit Carbo wheel used on its side by hand, with plenty of Carbo grains brought it to rough curvature in a hurry

'We made a concrete tool having approximate curvature and stuck glass facets on it with pitch It turned out to be a fast cutter and did not seize easily in the fine-grinding stage Clifford Crowe chauffered the mirror around on the lap for about 23 hours and I took a dozen spells of about three minutes each at figuring mostly with a small polisher, as the big mirror did not respond to overhang strokes for parabolization

"The mirror is mounted in a hexagonal ¾ plywood tube, on a 27-point flotation system very closely following Hindle's chapter in 'A T M ' It is rather critical on focus, being *f*/5, and images deteriorate rapidly toward the edge of the field, but the drive holds objects in the center and thus this deterioration is of little inconvenience We are inclined to think the wooden tube is better than other kinds we have used, from the point of view of image steadiness

For any such telescope I strongly recommend designing the tube saddle so that the tube, or else the whole upper end of the tube, will rotate, a method that pays out richly in comfort of observing at the eyepiece, which may thus at all times be used in a horizontal position "

WALTON mentioned the fact that his tool, built of a mosaic of plate glass pieces stuck to a background, did not easily seize to the mirror This is an example of the "broken" type of tool described by Ferson in the chapter on "Prisms, Flats, Mirrors," in printings of "A T M.A " issued since June 1944 Figure 2 shows a tool facetted by sandblasting after a couple of stages of coarse grinding This, Walton writes, is the tool he used in making a Schmidt He points out that this tool, and the mirror also, shows considerable transparency because fine grinding could be carried on as far as desired without fear of seizing, thanks to the breaks

While the broken type of tool is not

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90 AMICI PRISM 21m/m Face	ea	2 00
RIGHT ANGLE PRISM 23m/m Face	ea	1 25
RIGHT ANGLE PRISM 38m/m Face	ea.	1 75
GIANT RIGHT ANGLE PRISM 41m/m X 57m/m Face (flint glass)	ea	3 00
GIANT PORRO PRISM (grooved) 41m/m Aperture	ea.	3 25
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new—professionals often use it—Ferson, in making many scores of blocks of prisms cemented in blocks (thus, essentially flats) during the war, greatly developed its working philosophy. In "A T M A" he points out its superiorities, in a clear train of reasoning with which experience checked fully Turned edge had resulted from grinding with too much water, necessary, however, to avoid seizing If now the wets could be dried up really to refusal of the work to move further, he found there would be no turned edge And if the tool were channeled, the wets could be thus dried up—safely without risk of sticking As a by-product, the fine grit cut faster and pits were less troublesome—the whole story is too long to develop here in closer detail

Your scribe has subsequently used a tool much like the broken one described by Walton—glass facets pitched to an iron disk It worked fully as described by Ferson but scratched badly —until the edges of all the facets were chamfered, and thereafter it scratched not at all Another tool was given integral facets by grinding them in with the edge of a thick piece of copper against a straightedge clamped on, using Carbo Time, ten minutes a channel (say, 1/16" deep) and it paid fine dividends not a seizure in a shipload You could lift the mirror off without any effort at all, at any time

EXEUNT pencil mark test was the verdict reached in these columns last January, on evidence that this otherwise useful test, described in "A T M," page 288 (draw pencil marks across the fine-ground tool and mirror and rub the two together dry), sometimes leaves scratches or gouges, possibly by molecular, glass-to-glass cohesion and grabbing and probably not, as several have suggested, by grit in the pencil since the disks are first rubbed clean with the hand Such piteous pleas in extenuation of this Jekyl-and-Hyde accused were received that the sentence is suspended But a warning—"The above-described test may cause scratches"—will be inserted in "A T M.," page 289, line 2, and the suspect watched further

Fred B Ferson, Ferson Optical Co, Biloxi, Miss, advises us how the pencil test is made in his plant without rubbing dry disks together "We merely lift off the mirror and draw two lines across its face Without bothering to wash it we brush on a little more emery and grind half a minute or so On any zones not in contact the marks will show through the back of the glass if clear and, if not, wetting it will make it so Incidentally," Ferson adds, "emery does not stick mirrors, that fault lies largely with Carbo"

FOR WORKING 16" mirrors, now becoming the mode, a modified Draper machine is suggested, sub-diameter tool on top An article describing the basics of stroke length, stroke offset, stroke de-centering, and the respective effects on the curve, is in preparation. For the machine, see Strong's famous book, Figure 16

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Light up the twin projection systems and see both images fuse into one One fixed one moving and variable demonstrate virtual images TWO SUPERB ACHROMATS in threaded brass cells cemented doublets 2" dia 7¼ e f l tested perfect for telescope objectives! (Unusual—see instructions) 3 Precision first surface flats aluminized one 2¼" x 4¼" Reflecting glass sun filter Two 22v lamps in door changeable if another voltage is desired no rewiring Two reticles glass enclosed Stainless gears PLASTIC GEL CELL DEHYDRATOR with tell-tale colored silica gel

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N[illegible]olicy now applies to a total of 60 important types and makes of general purpose tools. See the next 3 pages for details of this high-speed sales program.

Floor Grinders—With Wheels over 6" Diameter and Driving Motors Other Than 110 Volt.

Boring Machine—Horizontal, Precision, Bridge Type, Single and Double End

Chucking Machine—Bullard Mul-au-Matic Vertical, Multiple Spindle Type.

Chucking Machine—Six Spindle Automatic, Horizontal.

Drilling Machines—Deep Hole, Pratt and Whitney.

Drilling and Tapping Machine—Multiple Spindle Automatic.

Drilling Machine—Multiple Spindle, Fixed Center-Drills, Natco

Gear Tooth Grinder—For Spur Gears, External and Internal (Formed Wheel Type Machine).

Gear Tooth Lapper—External and/or Internal Gear Tooth Lapping Machine

Gear Tooth Shaver—Rack or Rotary Type, External or Internal Gear Shaver.

Contour Cutter Grinder

Grinders, Cam and Crank Pin.

Grinders, Miscellaneous—Spline and Radius Grinders.

Lapping Machines—Flat, Norton Hydrolap.

Lathes, Production—Between Centers Automatic, Horizontal Single Spindle.

Slot Milling Machine.

Milling Machine—Spline

Milling Machine—Bed Type, Vertical.

Planer—Craven Bros

Screw Machine—Multiple Spindle Bar Type Automatic.

Vertical Shapers and Slotters

Speed Lathes—All Types and Sizes

The following types of tools were originally repriced on October 1st They are listed again because additional makes and models have been put on the new fixed price schedule

Gear Hobber—Horizontal

Gear Hobber—Vertical, Muir

Gear Tooth Grinder—Generating Type, For Spur and Helical Gears.

Milling Machine—Bed Type, Horizontal Spindle, Plain or Rise and Fall, Simplex or Duplex.

Milling Machine—Vertical, Knee Type Except Bench Models

Tapping Machine—Vertical, Single or Multiple Spindle

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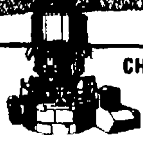
GOVERNMENT
WAA
SURPLUS

LATHES, PRODUCTION—BETWEEN CENTERS AUTOMATIC, HORIZONTAL SINGLE SPINDLE

Manufacturer: JONES AND LAMSON MACHINE CO., SPRINGFIELD, VT

MODEL	SIZE AND CAPACITY	SALES PRICE
Fay Automatic	8" swing x 21" center to center	$ 796 00
Fay Automatic	8" swing x 33" center to center	843 00
Fay Automatic	8" swing x 45" center to center	889 00
Fay Automatic	12" swing x 21" center to center	$1195.00
Fay Automatic	12" swing x 33" center to center	1261 00
Fay Automatic	12" swing x 45" center to center	1330 00
Fay Automatic	12" swing x 63" center to center	1465 00
Fay Automatic	12" swing x 81" center to center	1636.00
Fay Automatic	16" swing x 21" center to center	$2079.00
Fay Automatic	16" swing x 33" center to center	2148 00
Fay Automatic	16" swing x 51" center to center	2284 00
Fay Automatic	20" swing x 25" center to center	$1569.00
Fay Automatic	20" swing x 37" center to center	1638 00
Fay Automatic	24" swing x 60" center to center	2717 00
anufacturer: LODGE AND SHIPLEY MACHINE TOOL COMPANY, CINCINNATI, OHIO		
1 Duomatic"	16" swing over bed, 10" over slides, 38" centers	$1078 00
3A "Duomatic"	20" swing over bed, 10" over slides, 15" centers	1772 00
3A "Duomatic	20" swing over bed, 10" over slides, 27" centers	1826 00
3A "Duomatic"	20" swing over bed, 10" over slides, 39" centers	1879 00
3A "Duomatic"	20" swing over bed, 10" over slides, 51" centers	1932 00
3A "Duomatic	20" swing over bed, 10" over slides, 63" centers	1986 00
3A "Duomatic"	20" swing over bed, 10" over slides, 75" centers	2039 00
anufacturer: SENECA FALLS MACHINE COMPANY, SENECA FALLS, N Y.		
IP Lo-Swing	4 1/2" swing over front and rear carriage, 8" centers	$ 746 00
IP Lo Swing	4 1/2" swing over front and rear carriage, 12" centers	769 00
Lo-Swing	5 1/2" swing over front and rear carriage, 10" centers	768 00
Lo-Swing	5 1/2" swing over front and rear carriage, 16" centers	815 00
Lo-Swing	5-1/2" swing over front and rear carriage, 22" centers	$ 854.00
Lo-Swing	5 1/2" swing over front and rear carriage 34" centers	965 00
Lo Swing	5 1/2" swing over front and rear carriage, 46" centers	1021 00
14 Lo Swing	11 1/2" swing over front and rear carriage, 34" centers	2627.00
anufacturer: SUNDSTRAND MACHINE TOOL COMPANY, ROCKFORD, ILL.		
Automatic Lathe	8" swing x 15" center to center	$ 715 00
Automatic Lathe	8" swing x 21" center to center	757.00
Automatic Lathe	8" swing x 28" center to center	816 00
Automatic Lathe	10" swing x 10" center to center	$ 976 00
Automatic Lathe	10" swing x 22" center to center	1020 00
Automatic Lathe	10" swing x 34" center to center	1128 00
Automatic Lathe	10" swing x 46" center to center	1242.00
Automatic Lathe	12" swing x 22" center to center	$1126.00
Automatic Lathe	12" swing x 34" center to center	1233.00
Automatic Lathe	12" swing x 46" center to center	1349.00
Automatic Lathe	15" swing x 22" center to center	$1102.00



CHUCKING MACHINE—AUTOMATIC VERTICAL, MULTIPLE SPINDLE TYPE

Manufacturer: BULLARD COMPANY, BRIDGEPORT CONN

MODEL	SIZE AND CAPACITY	SALES PRICE
D "Mult au Matic"	34" swing 4 spindle	$19393 00
D "Mult au-Matic	8" swing 6 spindle	6136 00
D "Mult au Matic	12" swing 6 spindle	6506 00
F "Mult au Matic"	7" swing 12 spindle	6380 00

SCREW MACHINE—SINGLE AND MULTIPLE SPINDLE BAR TYPE AUTOMATIC

Manufacturer CONE AUTOMATIC MACHINE COMPANY, WINDSOR, VT

MODEL	SIZE AND CAPACITY	SALES PRICE
SK Automatic Screw Machine	1 1/2" diameter bar capacity 6 spindle	$3066 00
SN Automatic Screw Machine	2" diameter bar capacity 6 spindle	3307 00
SD Automatic Screw Machine	2 1/4" diameter bar capacity 6 spindle	3446 00
SE Automatic Screw Machine	2 5/8" diameter bar capacity 6 spindle	3932 00
SF Automatic Screw Machine	3 1/2" diameter bar capacity 6 spindle	4432 00
WW Automatic Screw Machine	1 1/2" diameter bar capacity 8 spindle	$3065 00
XX Automatic Screw Machine	1 7/8" diameter bar capacity, 8 spindle	3132.00
DD Automatic Screw Machine	1 1/2" diameter bar capacity 8 spindle	2360 00
YB Automatic Screw Machine	1-5/8" diameter bar capacity 8 spindle	3132 00
MM Automatic Screw Machine	1 7/8" diameter bar capacity 8 spindle	2529.00
Manufacturer: GREENLEE BROTHERS AND COMPANY, ROCKFORD, ILL.		
1" Automatic Screw Machine	1" diameter bar capacity 6 spindle	$2216.00
1 5/8" Automatic Screw Machine	1 5/8" diameter bar capacity 6 spindle	2636 00
2" Automatic Screw Machine	2" diameter bar capacity, 6 spindle	3269.00
Manufacturer: THE NATIONAL ACME COMPANY, CLEVELAND, OHIO		
3/8" R-6 Automatic Screw Machine	3/8" diameter bar capacity 6 spindle	$2105 00
9/16" RA 6 Automatic Screw Machine	9/16" diameter bar capacity 6 spindle	1602.00
1" RA-6 Automatic Screw Machine	1" diameter bar capacity 6 spindle	3036 00
1 1/4" RA 6 Automatic Screw Machine	1 1/4" diameter bar capacity 6 spindle	3465 00
1 5/8" RA 6 Automatic Screw Machine	1 5/8" diameter bar capacity 6 spindle	$4118 00
1 5/8" RB-6 Automatic Screw Machine	1 5/8" diameter bar capacity 6 spindle	4118 00
2" RA-6 Automatic Screw Machine	2" diameter bar capacity 6 spindle	4350 00
2" RB-6 Automatic Screw Machine	2" diameter bar capacity, 6 spindle	4350 00
2" RAS-6 Automatic Screw Machine	2" diameter bar capacity 6 spindle	$4350 00
2 5/8" RA 6 Automatic Screw Machine	2 5/8" diameter bar capacity 6 spindle	4969 00
2 5/8" RB 6 Automatic Screw Machine	2 5/8" diameter bar capacity 6 spindle	4969 00
3 1/2" RA 6 Automatic Screw Machine	3 1/2" diameter bar capacity 6 spindle	5781 00
Manufacturer: NEW BRITAIN-GRIDLEY MACHINE COMPANY, NEW BRITAIN, CONN		
60 Automatic Screw Machine	5/8" diameter bar capacity 6 spindle	$1778 00
204 Automatic Screw Machine	5/8" diameter bar capacity 6 spindle	1059 00
60 Automatic Screw Machine	1" diameter bar capacity, 6 spindle	2741 00
61 Automatic Screw Machine	1 3/8" diameter bar capacity, 6 spindle	$2299 00
61 Automatic Screw Machine	1 5/8" diameter bar capacity 6 spindle	3373 00
61 Automatic Screw Machine	2" diameter bar capacity 6 spindle	3560 00
61 Automatic Screw Machine	2 1/4" diameter bar capacity, 6 spindle	3662 00

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Scientific American

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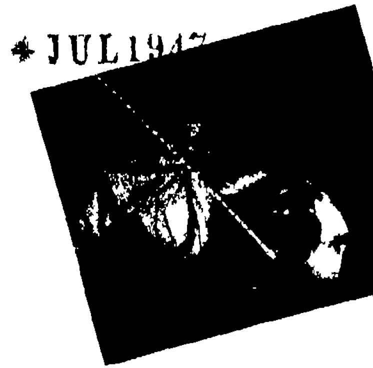

INDUSTRIAL DRAMA: Essential to profitable production processes of all kinds is accurate fitting of workers' vision to the tasks Details and case histories on page 245

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50 Years Ago in . . .

(Condensed from Issues of June, 1897)

TESLA'S WIRELESS—"Very recently Nikola Tesla has announced that he has completed his wireless telegraph to such an extent as to permit of telegraphy through the earth for a distance of 20 miles or more, and his experiments satisfy him of the feasibility of wireless telegraphy on a much more extended scale In fact, he aims at nothing less that the establishment of a system of telegraphy that shall include the whole earth, and by which items of news may be distributed from one political or commercial center to every other such center throughout the world This, Mr Tesla claims, is possible without the interference of one set of signals with another While Mr Tesla has been wrestling with this great problem in this country, Mr Marconi, a young Anglo-Italian, has been working on the same line in England under the direction of Mr Preece"

GAS ENGINES — "It is a noticeable fact that although the gas engine industry has been advancing with rapid strides in England and on the Continent, it has made comparatively slow progress in this country The causes are various They are chiefly to be found in the cheapness of steam coal and the high cost of gas in the United States It is reasonable to suppose that when this industry, which in respect of its proportions is yet in its infancy, has attained the importance which it has in Europe, it will tend to reduce the price of gas, especially such gas as is used for cooking and power purposes, and the gas companies, themselves, will undoubtedly benefit"

POPULATION — "Now that the city of Brooklyn and other suburban districts have been incorporated with the city of New York, the latter in point of population easily takes rank as the second greatest city of the world London, of course, comes first with its great total of 5,600,000 souls"

WOOD PULP—"While most branches of business have been languishing, the wood pulp manufacturers have had an unprecedented year of success, and, if the consumption of white paper is any indication of the true literary tendencies of the age, we have reason to congratulate ourselves upon the growth and spread of general education"

X RAYS — "To determine the nature of the X rays has, from the beginning, been a great problem for all investigators, and it still perplexes and baffles all Are they, in reality, light rays or rays analogous to light, but of much shorter wave length, or are they projected matter? Both theories have advocates?"

FLIGHT — "Scientific experiment has been carried on by many able inventors in working on what may be called the true flying machine This line of experiment has resulted in such great progress in the last few years (and especially so in the last six months) that the attainment of long, free flight for man, which not long ago seemed an invention for the far distant future, is a thing now near, if not quite at hand"

ALUMINUM — "In 1896 there were imported into Germany 591,500 kilos of crude aluminum Of these, 467,600 came from Switzerland, 55,000 from France and 8,400 from Austria In the first two months of the current year 138,900 kilos were imported, as against 65,900 for the corresponding month of the previous year"

THIRD RAIL SYSTEM — "The third rail system of electric traction is now in permanent operation on an important section of a leading steam railroad. The recent opening of the line from Berlin to New Britain and from New Britain to Hartford, while it is by no means the first successful operation of third rail traction, is notable as being its first application in a permanent way to the lines of a standard steam railroad The third rail conductor is of a special section rolled for this purpose The ends of the rail are bonded by sheet copper plates ⅛ inch thick, 4½ inches wide and 12 inches long, which are held against the under side of the flanges at the rail ends by iron plates The current is taken from the third rail by means of a sliding contact shoe, which consists of a simple cast iron plate Each train is made up of a motor car and a trailer Each motor car has two 125 horse power motors The danger to the public from the use of the third rail is considerably less than is popularly supposed, and in view of the precautions which have been taken to safeguard the ignorant or unwary, the chance of accident is very small"

100 Years Ago in . . .

(Condensed from Issues of June, 1847)

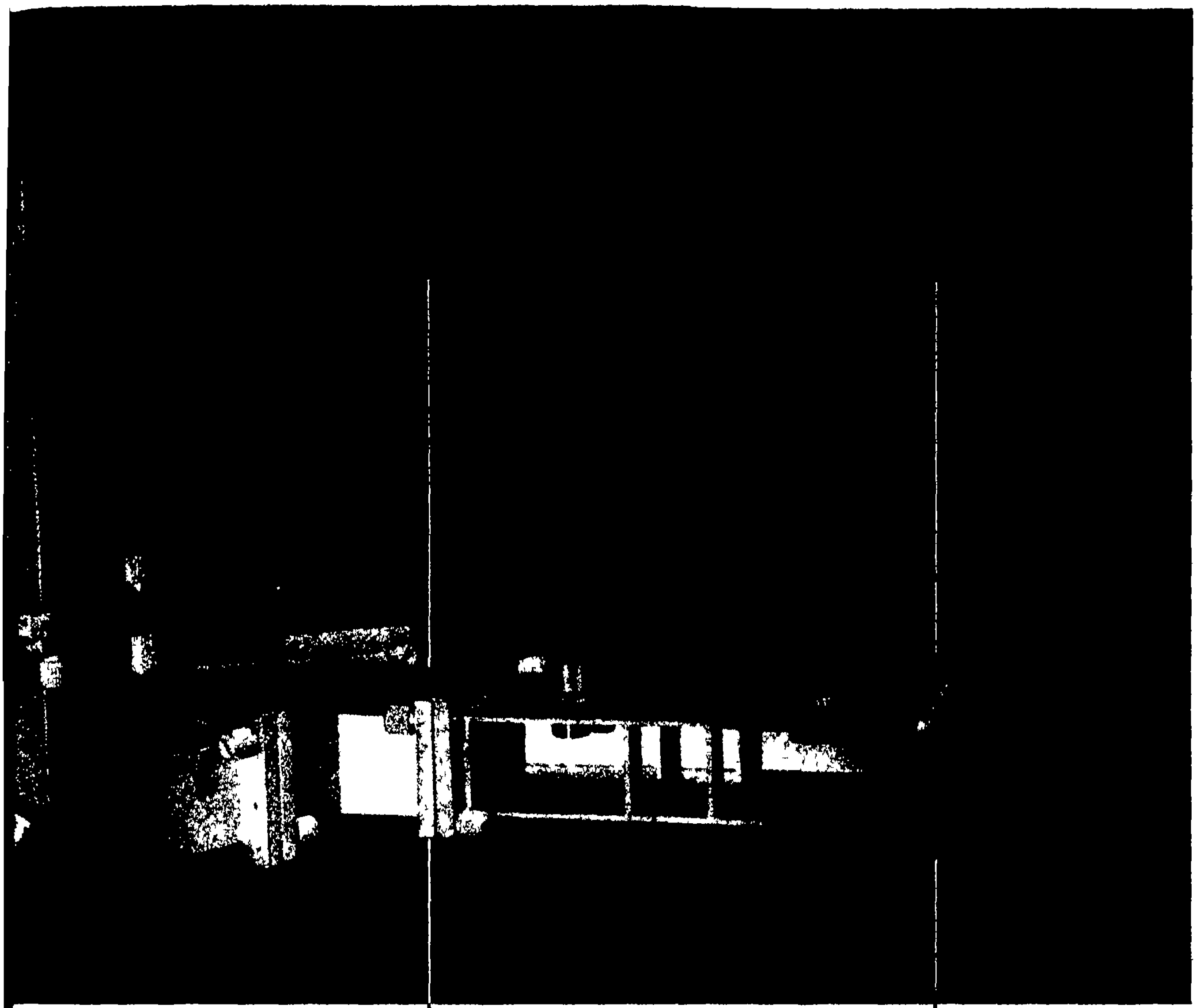
CASTING — "On last Saturday afternoon the 14th, Messrs T F Secor & Company, of this city moulded the Bed plates for the engine of the new Steam Ship United States, one of the four packets to run between New Orleans and Liverpool The casting weighed over 24 tons"

PRINTING PRESSES — "Messrs Hoe & Company are making two huge Printing Presses for the New York Sun All the motion is rotary, and it is calculated that in the saving of friction, and wear and tear by such means, the great amount of from five to twenty thousand dollars expense per annum will be avoided. It is calculated that these presses will be able to throw off 30,000 copies per hour"

CANAL BOATS — "About 1000 new canal boats are estimated to have been added to the New York Canals the present season, making with those previously registered, say 3,500 These at 80 feet in length to each, would make a line of boats over 53 miles in length!"

ASTRO-PHOTOGRAPHY — "To apply the telescope with the Daguerreotype in astronomical observations, has lately occupied the attention of the Royal Society of Bohemia. Professor Doppler says, that notwithstanding the extreme susceptibility of the human eye, it is surpassed many thousand times by an iodized silver plate"

CASEIN PAINT — "A foreign correspondent says that a paint has been used on the Continent with success, made from milk and lime, that dries quicker than oil paint, and has no smell"



he two filters in the picture (one with side ut away) are used to separate two radio hannels coming in on the same antenna but n different frequencies At the end of the onnecting waveguide, the channels are ade to part company each going to a ifferent circuit through its assigned filter

SEPARATION CENTER

FOR RADIO WAVES

Thirty years ago, when all telephone service went by wire, Bell scientists developed means of sending dozens of conversations over the same line

This they did by giving to each conversation a different *carrier frequency*, then to separate it from the others, they used a device which they had invented and named—the *electric wave filter*

Today, in microwave telephone systems, the message-bearing waves pass to and from the antenna in pipes called waveguides So scientists in Bell Laboratories devised a different kind of filter — a filter in a waveguide This filter is a system of electrically resonant cavities formed by walls and partitions Waves that set up sympathetic vibrations in the cavities pass through; others are reflected

In the Bell System, now, single circuits are carrying many conversations at the same time through precision wave-filtering

BELL TELEPHONE LABORATORIES

AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Previews of the Industrial Horizon

By A. P. Peck

NUCLEAR ENERGY . . . AND COST

Within the next 18 months or so, industry will come one step nearer to a realization of the comic-strip artists' and Sunday-supplement writers' dreamy-eyed views of atomic energy utilization. No, there won't be magic pills to run automobiles, or 'round-the-world airplanes with a fuel tank the size of a fist, or home heating plants with a life-time supply of heat in a capsule But there will be in operation at least one pilot power-plant generating electricity from a source of nuclear energy

Big question whenever power generation from nuclear fission is seriously discussed usually is How much will it cost? Most accurate answer to date is No one really knows But other answers loom on the horizon Pilot-plant tests will reveal a lot In the meantime, here is a statement from A. L Baker, vice president of The Kellex Corporation, who has played a leading role in the development of atomic power

"In evaluating the place of atomic power in industry," Mr Baker says, "we must keep in mind that the high costs, such as were involved in the war-time program for the separation of fissionable isotopes, are not involved in industrial applications People are too apt to think of atomic power in terms of hundreds of millions of dollars The fact is that the cost of an atomic power plant for industrial use is not greatly in excess of present costs of standard types of power plants We have to dismiss from our minds the idea that great sums are involved. Even tens of millions are out of the picture Actually, an atomic power plant could possibly be built for a few million dollars"

That's one view of costs Technical bugs there will be aplenty That these can be solved goes without saying because the means of solving them are within reach Practical applications of atomic power in the near or more distant future revolve around the cost factor, the technological factor—both largely predictable—and the completely unpredictable factor of international politics

INDUSTRIAL TELEVISION

Where there is an advantage of watching a process or operation from a distance, television furnishes a means One such use in boiler rooms was described on page 126, March 1947 Scientific American Still newer equipment broadens the horizon Time and motion studies, viewing processes that go on in closed vessels or in toxic atmospheres, removing operating personnel from hazardous to safe positions, are only a few of the ways in which industrial television is being put to work

DUAL-PURPOSE PACKAGING

Producers of consumer goods can boost public acceptance by giving more attention to packaging This has been amply proved by attractive packages, but there is a lot more that can be done. Belts in plastics cases that can later be used as cigarette boxes are one of the oldest examples of practical dual-purpose packaging Now comes cereal in a box that later becomes a child's toy Then there is the insecticide packed in a dispensing container, a whiskey bottle whose plastics case finds favor with the distaff side of the family, and a window cleaning fluid in a bottle from which the fluid is sprayed as needed

There is an endless variety of products whose manufacturers can profit by these few examples They range from face power through carpet tacks to machine tools Remember the old story of Ford's specifications for packing cases? As we recall it, parts purchased by the Ford Company had to be delivered in wooden cases of such size and material that, when taken apart, the boards could be used in the bodies of Model T's

Dual-purpose packaging can take one of at least three forms The package can dispense the product, can be put to other uses after the product is removed, or can serve (in the case of durable goods) as a permanent storage container

COMPETITION FOR LEAD

Now selling for more than double its war-held price of 6 5 cents a pound, scarce lead is once more coming into plentiful supply In the days of lead scarcity, however, other materials encroached on fields where the soft metal formerly held full sway Aluminum, for example, started into the foil market in a modest way, now it is bidding for the lion's share In collapsible-tube manufacture also aluminum has obtained a good foothold which present-day costly lead will have to fight hard to dislodge

Plastics, too, are eating their way into former lead applications They can replace lead in tank linings and pipes in chemical industry and in cable sheathing in the electrical industry Substitute pigments are being developed for paints, to take the place of time-honored white lead Glass and rubber offer many of the inert advantages of lead and are being used for jobs where lead was formerly the only material considered

STRAWS IN THE WIND

A "jet propulsion" heater for orchard protection against frost burns oil fuel without smoke, circulates warm air more efficiently than smudge pots, applications of the principle to industrial dehydrating and drying operations, where flame noise is not objectionable, are predicted Dreams of a helicopter in every backyard still seem far off, two-place flying "egg-beaters" are on the market—at $25,000 each All-natural rubber tires, when they again reach the market, will probably demand premium prices; tire manufacturers favor a blend of natural and synthetic.

J. 1947

Scientific American
JUNE • 1947

BETTER VISION Boosts Production

By Adopting Plant-Wide Vision-Testing Programs, and by Applying Corrective Aids Wherever They Are Found to Be Necessary, the Vision of Workers Can Be Brought to the Optimum. Results Will Include Better Quality Output, Greater Worker Comfort, Reduction of Accidents

By ALLEN C. HOLLAND, O.D.
Chairman Occupational Vision Committee
American Optometric Association

AN INCREASE of 20 to 25 percent in production can be achieved in the average industrial plant by the application of tried and proved rules for better vision.

This statement is based on the experience of hundreds of companies which are offering dramatic proof of the value of systematic better-vision programs. For example, one survey indicates that 37 percent of all spoiled work in industry is traceable to visual inefficiency.

Good vision pays dividends to both employer and employee. In one plant a group of solderers on piecework earned 14 cents an hour more than another with inefficient vision, largely because their work was of better quality, measured in fewer rejects. A company reported that it earned 5 percent more on capital invested in equipment used by employees with efficient vision compared to those who rated substandard.

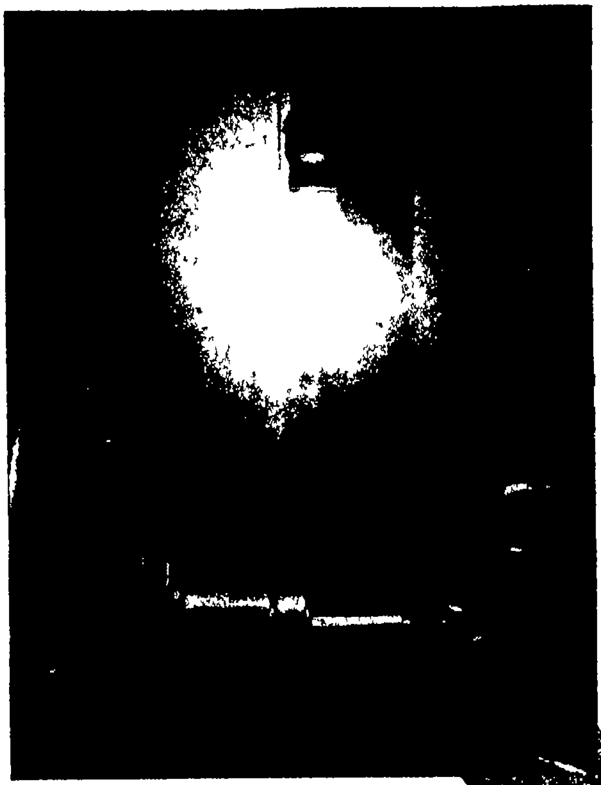
An employer who instituted a visual corrective program and established better lighting, raised production 19 percent and improved quality 16 percent.

Industry is just beginning to recognize the part vision plays in safety. Every ten seconds a worker is injured, the financial loss being about 2.5 billion dollars a year, and many accidents are due to inefficient vision. The worker who does not see

Courtesy National Better Light Better Sight Bureau

Planning that avoids glare and shadows also reduces accidents and spoiled work

Linlithgow Library
Imperial Agricultural Research Institute



Courtesy Better Vision Institute Inc

Open lights, improperly placed, produce uncomfortable glare and cast deep shadows on work Results Inferior workmanship, high accident rates, increased spoilage

properly is dangerous both to himself and his fellow workers

Establishment of good vision is not a panacea for industrial inefficiencies, nor for high accident rates, and there is no single secret to good vision However, experience in industry has made it possible to lay down some specific principles which, if followed, are likely to prove profitable for any company

An encouraging fact is that more than 90 percent of industry's vision problem can be solved by the simple procedure of bringing each employee's vision up to its highest possible level through professional attention

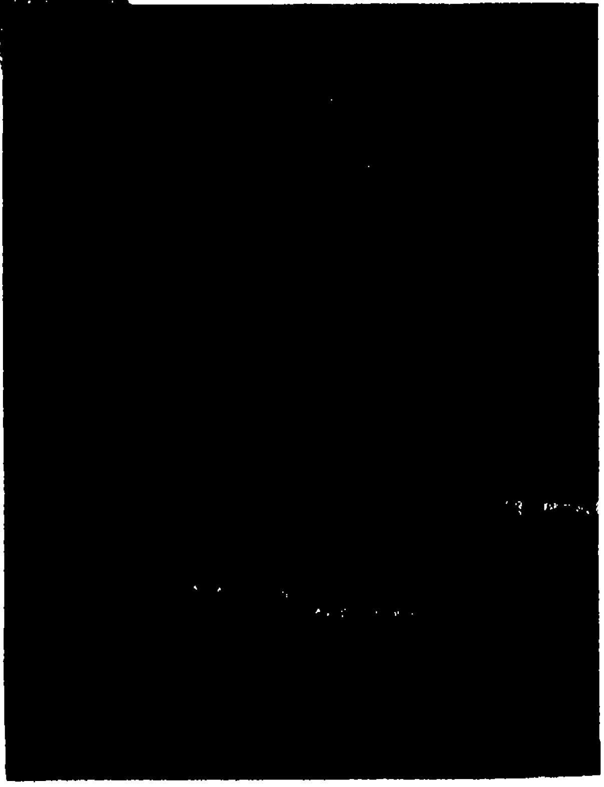
The objective of a better-vision program is not to screen employees out of industry, but to improve visual efficiency and to help match the employee or prospective employee to the job for which he is best fitted

MOST TESTS INADEQUATE—Today only one company in seven has anything like an adequate vision program In many companies there are no vision tests, and in hundreds there is nothing but the common Snellen test in which one reads letters on a chart at a distance of 20 feet This is of little va'ue in the scientific program which industry needs A person with normal vision rates 20/20 in this test, but "normal vision" as measured on a distance chart may not be satisfactory for near work A job may require good vision [illegible] if the work is done a [illegible] 60 feet if it involves [illegible] crane The Snellen te [illegible] indication of one's su [illegible] particular job It is neces [illegible] beyond it in matching [illegible] jobs

In a group of about 200 workers who performed an intricate looping operation at very close range in hosiery production, it was found that those who had "poor vision" by the 20-foot visual discrimination test were consistently better producers In other words, those who were below normal by the common standard were superior for this particu'ar job If workers had been picked for this job by the Snellen test alone, the best operators would probably have been rejected

Through hundreds of generations man was an outdoor animal requiring eyes that focused best at a distance—on the animal he stalked or on the enemy on the far horizon It is only in the last few generations that so many millions have become dependent on occupations that require near-point vision, and much must yet be done to make our vision what it should be at the working point

SPECIALISTS NEEDED — When a company decides to institute a better-vision program, one of the first requirements is to realize the importance of a vision specialist The optometrist is such a specialist He makes a complete visual analysis and prescribes and adapts opthalmic aids, or administers visual training where necessary He is trained to recognize disease in the eyes and when such is found to be present he refers the patient for other pro-



Properly shaded lighting eliminates glare and reduces shadows. The workman can see his job better, is less prone to accidents, and will spoil less material under these better lighting conditions

• LOOKING AHEAD •

Jobs throughout industry analyzed from the standpoint of vision requirements Minimum visual standards for each job established, meeting which will become as important a consideration as aptitude, experience, and training Company-supervised vision programs aiding safety and efficiency

fessional care The opthalmologist and oculist are physicians specializing in the pathology and surgery of the eyes

Professional services may be obtained either by maintaining complete facilities and personnel within the company, or through outside practitioners

A better-vision program must be a co-operative project involving teamwork, particularly of the vision specialist, foremen, and engineers who together can determine the visual requirements for each job and the visual standards which the employee should meet for adequate job performance

There should also be teamwork in seeing that lighting and painting make maximum contribution to visual efficiency Some of the questions to consider are

Is there adequate lighting, particularly in critical work areas?

Is maximum use made of light and paint to make the environment pleasant?

Are contrasts used to aid discrimination?

"Before" and "after" (above and below) adequate lighting for good vision was installed in a foundry

Is there a minimum of glare?

Illuminating engineers have done a great deal of research in this field, and advantage should be taken of the service they can give

A VISION PROGRAM — The major steps in a better-vision program for an industrial company are

1 Sell the program to employees by explaining it fully

Courtesy National Better Light Better Sight Bureau

2 Analyze each job to determine its visual requirements, hazards, and so on.

3. Test vision of employees and prospective employees by methods which determine suitability of the individual to his particular job requirements

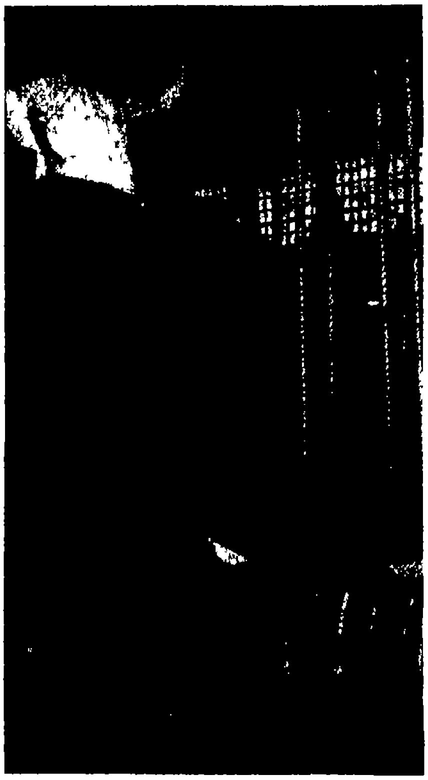
4 See to it the necessary corrections are not only prescribed but actually made—proper lenses, proper fitting, eye training, and so on

5 Make sure that protective-corrective eyewear is used where needed

6 Re-check periodically, particularly employees who are accident-prone or who have unusual visual problems

Selling the program to employees is an industrial relations job, the importance of which cannot be overemphasized Unless the program is frankly and thoroughly explained, over and over, there will be rumors that it is a scheme to screen out workers An early step should be to make the program clear to union leaders When they are convinced that it is beneficial to all they will help sell it Employee meetings and the company house organ may be used in an intensive educational program Supervisory employees should be thoroughly informed so that they can answer questions and allay fears

JOBS ANALYZED — Job analysis from the standpoint of visual requirements is a comparatively new subject, but it is not as difficult as it may seem As has been said, visual acuity at 20 feet does not tell much about one's suitability for a



Courtesy Better Vision Institute Inc

Although near-point vision is usually one of the biggest problems in industrial sight, some jobs also require good vision at a distance. An example of this requirement is found in the case of the overhead crane operator

particular job. Some of the more common requirements in typical industrial jobs are:

Near point vision. Work point for the hosiery mill operators who made loops with fine thread was about eight inches from the eyes. Most bench and desk work is done with greatest comfort when the eyes focus and see properly at a distance of about 14 inches. Near point vision is one of the most important factors in an industrial program. Although some jobs require both near point and distant vision, few require distant vision only.

Depth perception. Most skilled industrial jobs require ability to judge relative distances. In assembly of small parts, or in adjusting work in a machine, good depth perception is essential. It is also an essential to the automobile and truck driver.

Field of vision. In most jobs one must be able to see to the sides as well as straight ahead and, where work moves, one must be able to follow it comfortably with his eyes. Too small an arc of vision makes one especially prone to accidents because he fails to see danger approaching from the side and, equally important, he is dangerous to his fellow workers.

Color discrimination. About 8 percent of all men and ½ of 1 percent of all women are color blind, and there are wide variations in ability to discriminate between colors by others who are not rated as color blind. Color discrimination is essential only in some jobs.

It is not difficult for a vision specialist and a foreman or engineer to check each job on such major points as these. A tabulation can be made of whether the worker in a job must, or need not, be normal or above on each point. Often slight changes can be made in lighting, placement of work, location or adjustment of machines, and the like to make the visual requirements simpler.

MATCH MEN AND JOBS — When the job requirements are tabulated, each employee and prospective employee should be given visual tests to determine whether his visual skills match the requirements set up for his job. Here, again, it should be stressed that if his visual skills do not match the job he has or wants, there are more than 90 chances in 100 that they will match that job or one equally good in the same plant when the usual corrections have been made. Visually as in every other way there are wide individual differences, but job requirements fortunately vary just as widely. Industry can accommodate even the blind.

The most common corrective measure is fitting proper lenses, although in many instances visual training to improve visual facility brings about corrections which cannot be achieved by spectacles.

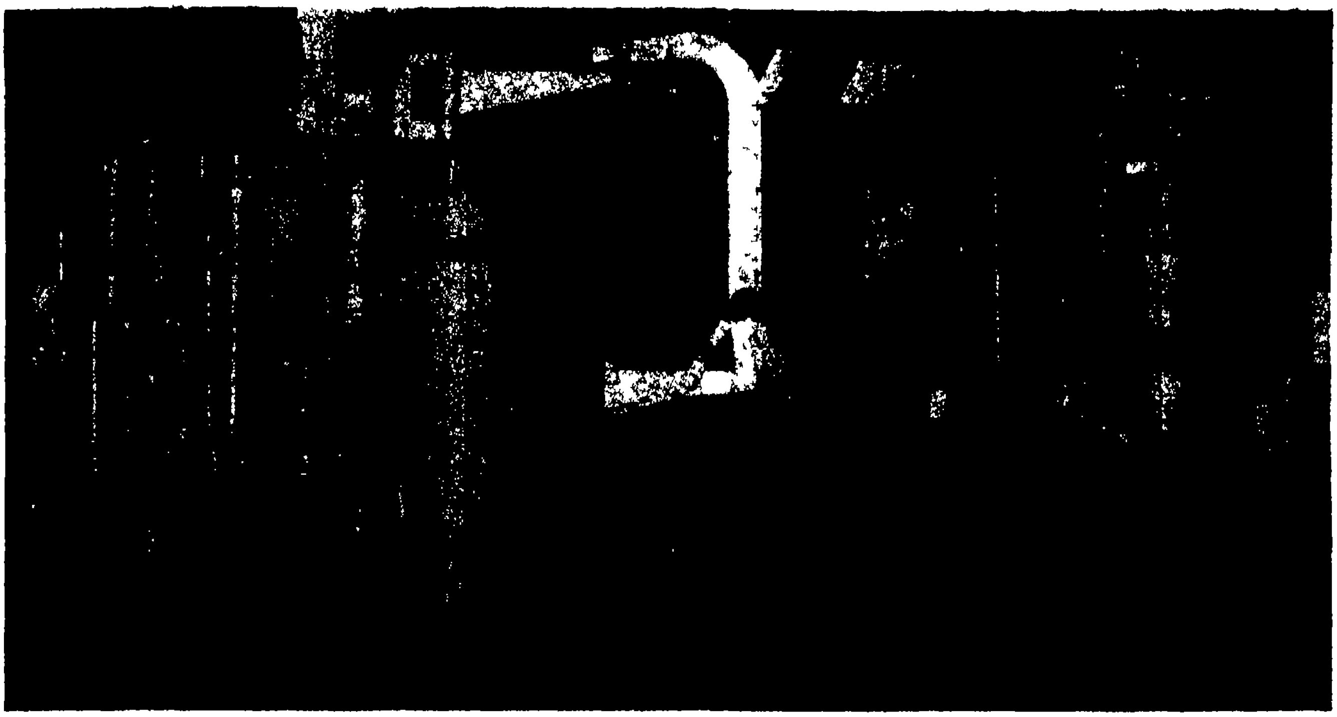
When lenses are prescribed there should be careful re-evaluation to see that the prescription is properly filled and the spectacles properly fitted. Sight is not a simple mechanical process, like a camera recording a picture. It involves mind, muscles, and nerves, and one of the principal objectives in a better-vision program is to help each employee to see comfortably. The worker who sees without undue effort is less subject to fatigue and its attendant psychological and physiological disorders, and is likely to be a higher producer and a safer worker.

If you go out into your plant you may find many employees with their spectacles or safety goggles in their pockets. Something is wrong with a vision program when this is too common. One of the preventives is to have frequent re-checks. This is especially important for employees known to have out-of-the-ordinary inefficiencies or those who are accident-prone. Visual capacity changes with age and under strenuous working conditions, lighting and other factors also change. The spectacles which are right today may be unsuitable in a few months.

Asking the question, "Do you see comfortably?" is a good test of a company's vision program. If there are only a few negative answers, the chances are that insofar as vision is a contributing factor the production per worker is high and the accident rate is low.

Courtesy Better Light Better Sight Bureau

A light-meter removes guess-work from the job of determining whether adequate standards of lighting for near-point vision are being met at this lathe



Clad steels lead to new heat treating methods

Processes have Families

By EDWIN LAIRD CADY

Significant Industrial Developments Invariably Initiate Great Series of Inventions, Refinements, and Modifications So Broad May be the Scope That Ultimately Not a Corner of Industry is Unaffected

Before this year is over, the Lukens Steel Company will have announced new kinds of stainless clad steels In the making are new and dramatic studies of the sciences of stress relieving, as worked out by scientists of that company Competitors Allegheny Ludlum, Republic Steel, and the others are hot on the same trail, will have announcements and papers of their own

Products of those kinds are not created over night, and neither are the scientific papers that go with them The two are counterparts of each other Every new product or process brings whole tribes of machines and other products into the world The speed with which these grow depends upon the scientific papers And as the tribes grow so do the new developments themselves become strong and healthy

Clad steels, for example, lead to welding They lead also to brand new heat treatments, and to new metals-cutting processes All of these new processes or variants of old processes need either new equipment or adaptations of old equipment, much of which has yet to receive its first pencil marks on the draftsman's schematic sketch pad

There are reasons for putting stainless steel cladding on ordinary carbon steels Stainless steel is resistant to corrosion, is highly resistant to wear, and has high ratio of strength for a given weight But the carbon steel averages less than one sixth the cost of the stainless, is much higher in its ability to conduct heat, has plenty of strength in its own right, and is much easier to fabricate by welding, machining, forming, or any other process

Put the two together and a great many problems are solved—and a great many new difficulties are created

CLADS WILL GROW — Many a product needs to be corrosion- and wear-resistant on its surface only Make that product entirely of stainless, and its cost is higher than for the clad Many another product has to be corrosion-resistant and at the same time has to conduct heat Make that one entirely of stainless and

• LOOKING AHEAD •

New tools and techniques making stainless clads as workable as carbon steel Methods and equipment thus born aiding all branches of metal working The end result—more efficient handling of a great variety of materials, many of which are in no way related to the stainless clads

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the heat conduction goes down so that the heat is localized It is much easier to burn food in an all-stainless pan than in a carbon steel one But make the pan of clad steel and the corrosion resistance of stainless is combined with the high ability of carbon steel to spread the same temperature to all parts of the pan

The same difference of qualities cause the troubles Try to roll, stamp, or swage a clad sheet and the carbon steel flows easily beneath the pressure while the stainless portion holds back Try to machine it and the two alloys need entirely different tool angles, cutting speeds, and feeds Try to weld it and the stainless needs different rods, electrical currents for flash or resistance welding, stress-relieving treatment after welding

Industry never is defeated by such difficulties Stemming from the scientific papers and bearing their real fruit in the more direct and diversified articles in the technical magazines will be the answers

Equipment makers will put these answers to work There will be hundreds of new furnaces and clamps for taking the residual stresses of welding out of clad steel products without allowing the carbon and stainless steels to distort each other New salt-bath techniques will attack the same problem New welding machines, welding rods, punch presses, bending rolls and brakes, metals spinning machines, cutting oils, flame machining equipments, will come along Many a product will be designed to have the stainless-steel component flat or otherwise contoured as received from the steel mill, the machining and other forming to be applied to the carbon steel component only This technique will bring greatly increased use of shapers, planers, and milling machines

The changes will not stop with their applications to clad steels Other products, such as castings forgings, and extrusions, also need better stress relieving and better all around processing techniques The developments created by problems of clad metals will improve dozens of products which compete against clad metals

TOOL PROPAGATION — On the subject of newly developed clad steels it is necessary to look prophetically Industry can see much, but by no means all, that is going to happen Tungsten and other sintered carbide tools, however, are older and better developed Industry can look at their effects historically

Without stampings, there might be no electron tubes

Sintered carbide tools were first developed in Europe The Germans hoped to win World War I with them Such tools could machine steel at rates as high as five times those possible for high-speed steel tools The man power thus freed from the factories could be put into the trenches

Machine-shop operators in the United States soon found that the material had a handicap Carbide was somewhat brittle This had meant little to the Germans who believed in manual controls for machine tools A skilled man who operated a lathe could change his feeds and speeds and make other adjustments when the cutting conditions threatened to break the tool But our practice was to use automatic, semi-automatic, and integrated controls Our labor could run machine tools after a few months of training, whereas the German mechanic was trained for years If we wanted to use the carbides, we had to improve the machines There followed 20 years of intensive development It is still going on

Lathes and other machine tools were completely redesigned to make them stiffer Many of the deflections which had permitted the tools to get slightly out of line had come from the actual bending of machine members under working stresses Now the members must not bend, and the stresses might be as much as 50 times higher

New and stiffer cast irons, such as the Meehanite types, were put into machine tools Preloaded ball- and roller-bearings, bearings which retained all of their anti-friction characteristics but had heavy initial loads on their rolling members to take out the initial elasticity, were put into the mountings of machine-tools spindles and other important members Elasticity at the bearings could mean deflection at the tools, and deflection meant broken carbide

NEW SCIENCE BORN — Vibration would break carbide tools Stiffening the machines did not seem to take the vibration out A special science of finding the causes and cures of machine vibrations was born Pads of rubber and cork, sometimes weighing several tons, were put under heavy presses and other percussion machines so the heavy hammer blows at those machines would not appear as vibrations at nearby lathes Vibration usually appeared at the sonic frequency, or a harmonic of the frequency, of some members of the tool mounting All parts of machine tools were tested for their sonic frequencies, and redesigned so that the frequency of

Carbide tools, when first developed, were easy to use with manual control. But the carbide family had to multiply before the tools could be successfully applied to automatic and integrated machine control.

one member would dampen that of its neighbor. Special metallurgical structures were developed in cast metals. Those structures were dampening to vibrations.

Slowing downs of machine speeds under heavy cutting loads had been taken for granted. But the slightest variation of this kind could break a carbide tool. New electric motors were designed and with them better V-belt drives and flat belt drives and chains and gearing. The positive actions of clutches took on new meanings. Machine-tool spindles no longer slowed down when the cuts became heavy.

Cutting oils were improved. The carbide tools did not need them so much, but the heat of higher cutting speeds tended to expand the work pieces and lose the accuracies unless cutting oils kept them under better control. Every device which held, controlled or guided a tool came in for its share of attention.

On some tools and applications, carbides simply could not be used—lathe tools making heavily interrupted cuts for example, and drills which were apt to release their cutting pressures suddenly when they encountered porous shrink areas within sand castings. But all the improvements for the sake of carbide tools had been improvements for high-speed tools too. Every operation which could not be performed by carbide now could be handled to immensely better advantage than ever before by high speed steels. But the development was not finished. Carbide tools were saving money. That money could be spent on higher accuracies, better heat treatments, higher strengths in machinery for the same weights.

More and better grinding machines came into use. Lapping, honing, super finishing so that the variations from true flatness or other contours of surfaces could be held to less than one-millionth of an inch all became commercial processes. Intensely close control of heat treatments so that the strength and hardness of a machine part could be predicted within very fine limits was also developed by spending the money saved by carbide tools. As one process promoted another, the modern automobile, airplane, and television set became possible.

MATERIALS MULTIPLY — While all this was going on, the raw materials makers were not idle. If not uniform in their constituents hardnesses, toughnesses, and machinabilities alloys also can set up shock and vibrational loads which will break carbide tools. The steels were made more uniform, more dependable. Uniformity had to be even better for grinding, lapping, and heat treating. The steel metallurgical laboratory formerly had been a quiet corner where long-haired metallurgical scientists could draw their salaries provided they did nothing to disturb the production line. The production line now has become a body of which the metallurgical department is the brains.

There is not a chemical process, power plant, production textile machine, mechanical refrigerator, engine of war, nor any other product which has not changed, and changed radically, because of the improvements in machine tools which carbide tools instigated.

Metal stamping is in similar case. The continuous steel strip mills with their hundreds of electronic tubes and thousands of miles of electrical wiring are but servants created by a stamping industry which needed their products. Electronic tubes themselves might be impossible to make at commercial prices if there were no stampings.

Dozens of other materials and processes are coming along. Their children and tribes will change the trends of history just as surely as did the abrupt and unforseen hordes of Ghenghis Kahn.

Precision investment-casting is a process to watch, and powder metallurgy, and argon gas as a servant of welding, and of every metal process which needs controlled atmospheres.

The greatest industrialist of all time would be a man who could watch the scientific papers for basic principles of such developments, watch the technical and scientific magazines for down to earth factual reports on progress, and then predict what families of materials and processes were going to be born, and how soon they would become strong.

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HYDRAULIC ACCUMULATORS

Designed for Aircraft, Find Wide Industrial Uses

AIRPLANE accumulators used to actuate the hydraulic landing gears and other mechanisms of airplanes, are simple, light-weight devices consisting generally of cylinders having opposed pistons or other moving members to accomplish the same purposes. At one end of a piston will be air, and at the other, the hydraulic fluid. Applying force on the hydraulic fluid drives the piston, compressing the air. Releasing the hydraulic fluid valve permits the compressed air to expand, moving the fluid which in turn actuates the mechanism. If the actuation is wanted only at reasonable intervals then the fluid can be pumped very slowly into the accumulator, thus securing plenty of quick power at low power cost.

Machinery makers have been grabbing the war surpluses of these accumulators as fast as they can find them, using them to actuate mechanisms of welding machines, plastics presses, paper making machines, or booster mechanisms for conveyors. The industrial market for airplane accumulators threatens to outstrip the aircraft one.

Demobilized Microwaves

Microwaves, Having Long Been Publicized as One of Our Greatest Military Tools, Are Now Finding Their Place in Civilian Industry. Here They Are Adding New Techniques to Established Electrostatic Heating Methods, Lending New Speed and Efficiency, Opening New Uses

By VIN ZELUFF

Associate Editor Electronics

Developments and applications of electronics in recent years, replacing older methods of doing certain jobs, are rapidly being expanded into still wider fields, and even are themselves being replaced by newer electronic techniques that can do a faster, cleaner, more efficient, and more economical job.

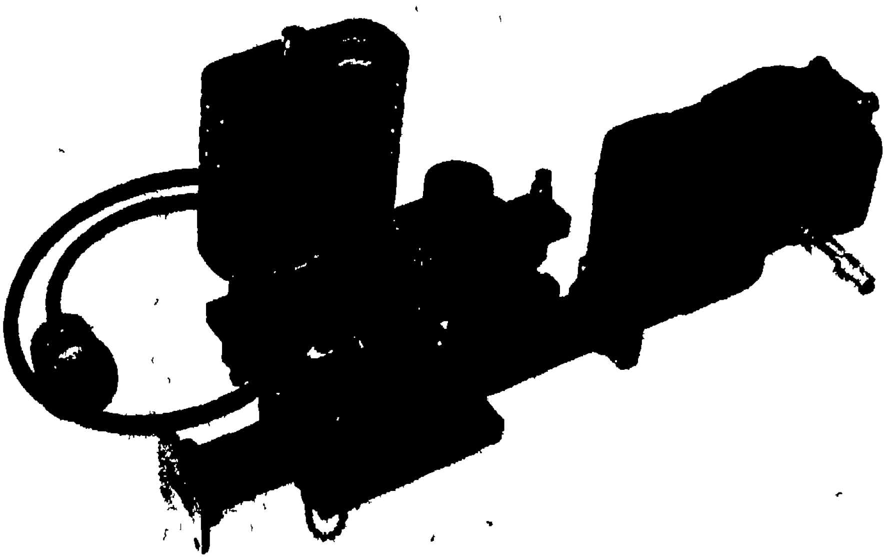
One expanding technique is that of dielectric heating. For many industrial applications it has done work that no other method has ever done before, yet even these methods may be relegated to the limbo of forgotten processes as tubes and circuits for microwave generation—of frequencies greater than 300,000,000 cycles—are further developed and applied.

Almost all of the microwave tubes that have been built in mass production for war use operate to supply radio-frequency power for only a small fraction of a second at a time. Although the peak power produced during that short interval of time is on the order of a few million watts, the average continuous power is seldom over one thousand watts. This amount of average power is useful for heating a small batch of material, about the size of a man's fist, for example, but for many industrial applications several thousand watts are required to do a good heating job quickly on the area, mass, or quantity of object that is to be heated.

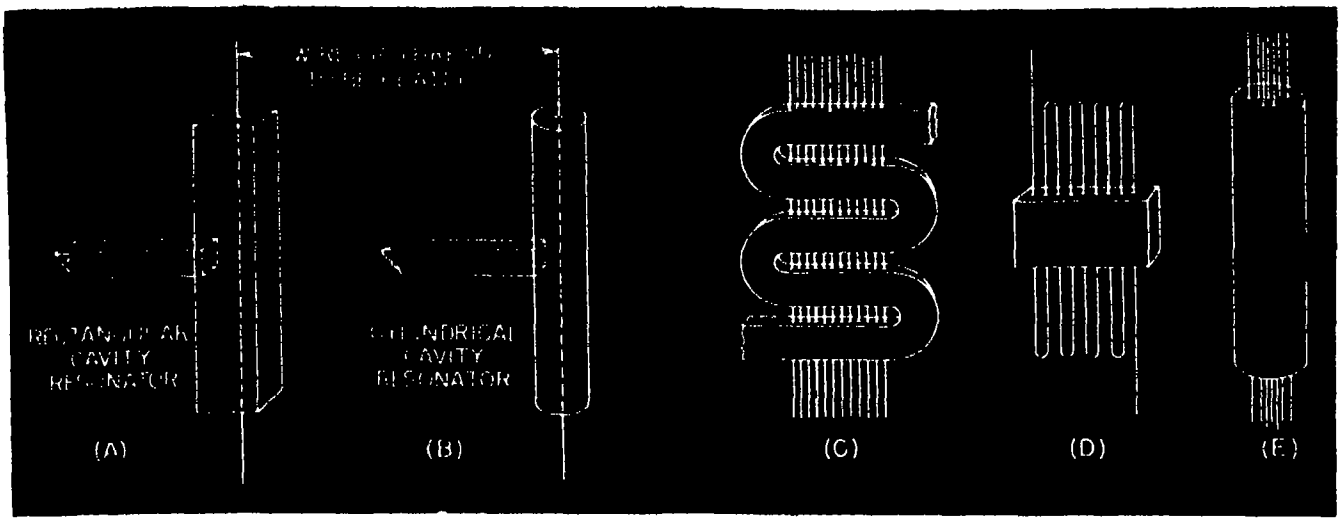
Even if the extremely high power that is developed by microwave tubes during the extremely short interval is fed to the conventional type of electrodes used in dielectric heating, the work piece would be subjected to tremendously high voltages momentarily, and a considerable number of precautions would need to be observed to prevent damage due to arcs flashing between the electrodes and through the material being treated, causing searing and burning.

Now, however, two tube types are available for continuous microwave heating—the resnatron and the split-anode magnetron. The latter develops ten kilowatts of radio-frequency power continuously at an efficiency of 50 percent. This power is produced at wavelengths between 0.4 and 0.9 meter. The resnatron, a higher-power type of beam tetrode (big brother of the beam-power 6L6 output tube used in radio sets) can be used at wavelengths between 0.1 and 1.0 meter as either an amplifier or an oscillator. Under continuous operation, it is capable of handling about 50 kilowatts of radio-frequency power at an efficiency ranging up to 60 percent. In other words it draws about as much from the power line as 850 hundred-watt lamps would take.

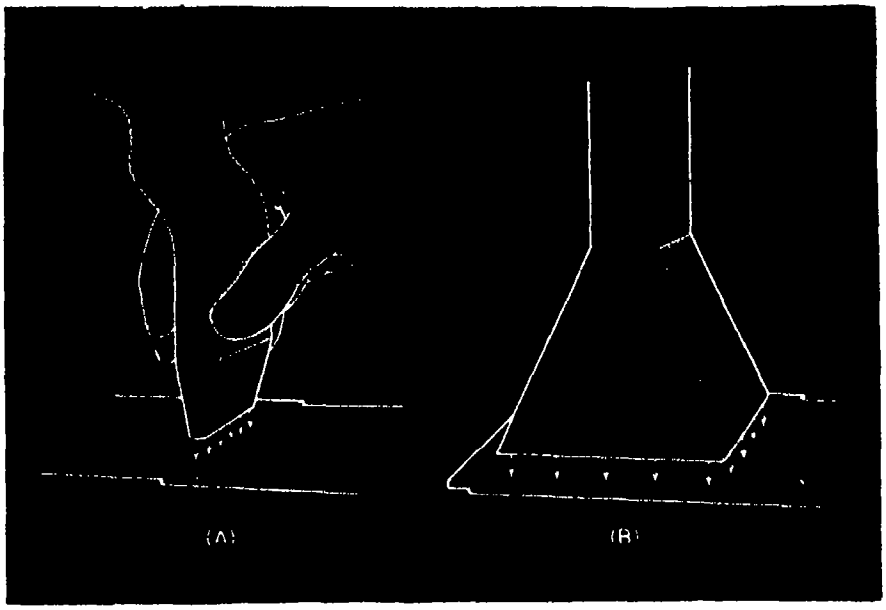
WAVEGUIDES -- One of the characteristic peculiarities of microwaves is that ordinary types of electrical transmission lines cannot be used. Such lines act very efficiently as antennas, and radiate the electromagnetic power into space, instead of conducting it to the work. Ordinary insulated wire leads connected to electrodes in a dielectric heating installation are useless at the microwave frequencies. "Waveguides" must be used for conducting the microwave electromagnetic power. These consist of actual copper pipes highly refined it is true, but nevertheless pipes. With silver-plated interiors, special gas-filled affairs in



The oscillator tube of this packaged microwave generator is the magnetron, shown at the extreme right surrounded by its two powerful permanent magnets. The output waveguide connection is made to the rectangular flange at left



Various methods for applying microwave energy to threads and wires (above), and also to sheet materials (right)



• LOOKING AHEAD •

Continuous, high-speed production of such thin materials as printed cloth and paper, sheet plastics, and plywood Rubber, nylon, and rayon thread materials produced at a greatly increased rate Cooking of hot dogs, cakes, and even complete meals accomplished in a matter of seconds

some instances, these hollow pipes act as conductors of electromagnetic waves or project them from an open end

Another important microwave accessory that is difficult to visualize is called a resonant cavity This consists essentially of a specially dimensioned section of waveguide in which electromagnetic oscillations can be made to occur, just as sounds of a certain frequency are produced in the cavity of a whistle or organ pipe Electrically the function of such a cavity is similar to that of the tank circuits in conventional radio sets

A cavity resonator can be used for heating rapidly moving thin sheet material An electromagnetic field of uniform character is created which is maximum at the center of the cavity or guide By passing strip material through slots at the top and bottom of the cavity it is subjected to the strong field Because standing waves are formed along the length of the cavity, however, the material would be heated unevenly if passed straight through the cavity (Electrical standing waves are alternating points of high and low electrical intensity along the path, just as waves on water are alternate high and low points on the water's surface) Making the entry and exit points a half-wavelength apart, and passing the material through the cavity at an angle, insures uniform heating

USES OF HEAT — Many industries now use dielectric heating for drying curing, or setting resins or glues in continuous processes Cloth is dried after dyeing, printed cloth requires rapid drying of the inks, and paper is often dried by this process Some of this work is done in bulk, with the material being placed between the electrodes of a dielectric heating generator In other cases, the material is passed in strip form between the electrodes, which are then necessarily placed close together This latter condition causes some difficulty, however, as the voltage produced between the electrodes at conventional frequencies is quite high, and there is the danger of flash-over through the material

For thin materials such as paper and cloth, it is difficult to apply sufficient voltage to the electrodes without flash-over, and still obtain enough heat in the material Use of microwave energy from waveguides eliminates the electrodes and their attendant high potentials and should allow high-speed automatic heating of the thinnest materials

Many commercial heating jobs can be done by this method of sending radio waves through pipes Bonding and drying of wallboard materials, floor covering materials such as linoleum, and plastics-bonded cork materials are only a few applications Continuous curing of sheet rubber, plastics, and synthetic materials, and production of plywood on a continuous basis are still other likely applications

In some cases it may be desirable to heat sheet material with a microwave antenna similar to that used last year in sending radar signals to the moon The antenna is put to work as a means of coupling energy into the material to be heated Such a "bedspring" antenna is designed to have uniform distribution of field and can be used to heat a large sheet of material The shape of the antenna is somewhat flexible and can be modified for efficient heating of various widths and shapes of material

HIGH-SPEED HEAT—Thread materials such as rayon and nylon must be cured, dried, and the twist set during manufacture Rubber thread material, both synthetic and natural must be cured Many insulating coatings on wire, either rubber synthetic or enamel, must be dried or cured For all of these operations heat must be applied to the material at high speed With conventional heating frequencies it has been impossible to couple energy into such materials at a rate suitable for mass-production requirements

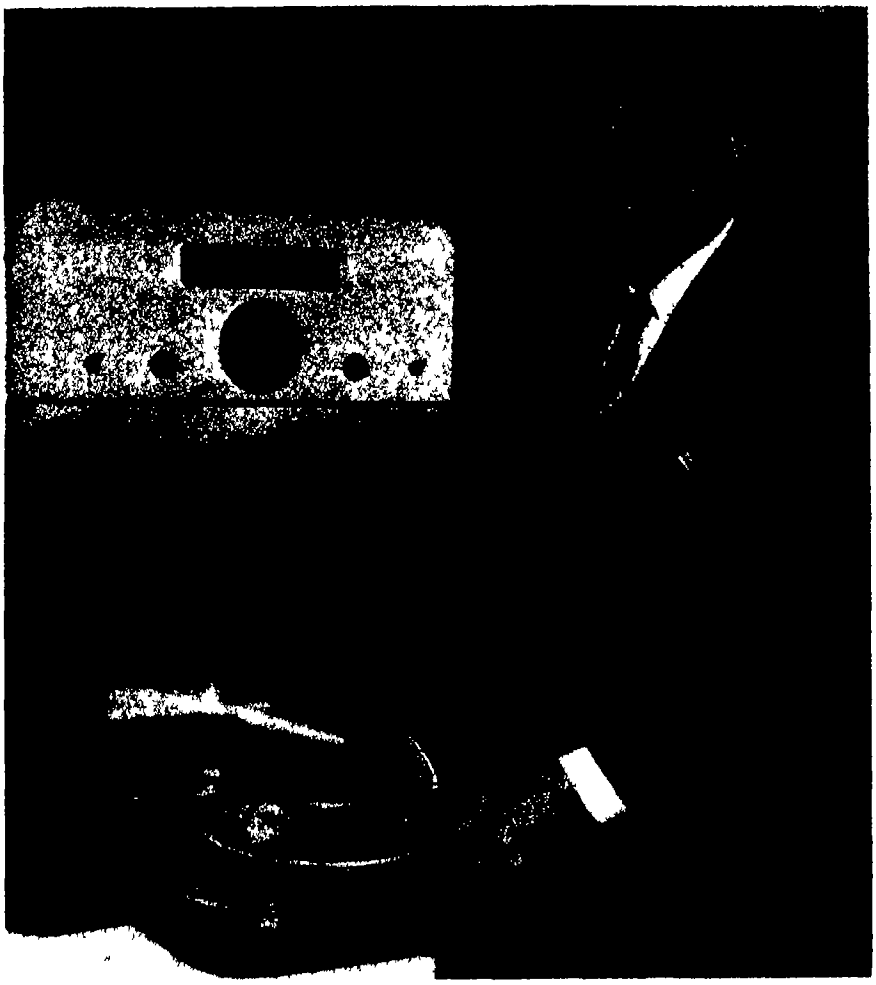
Microwave energy can be applied to these materials in a long cavity through the center of which is passed the wire or thread that is to be heated For efficient production a number of wires or threads can be passed through at once lengthwise or through holes in a folded section These same means of increasing coupling efficiency could be applied to sheet material

In the lumber industry, many problems of gluing await solution by dielectric heating Spot gluing and edge gluing could be accomplished by the concentrated field made possible through the use of openings in waveguide structures Holes in folded sections of waveguide structures would apply concentrated fields to the glue line

Continuous bonding of plywood by passing it through a slot in a cavity would make possible a process which has not yet been tackled because of the major difficulties encountered by conventional press designs and curing methods

In the plastics industry, radio-frequency energy is widely used for preheating material prior to molding Conventional frequencies used in dielectric heating adequately supply the heating rates normally used for hand-fed press operation High-speed automatic operation could now use radio-frequency energy to advantage, however, if sufficiently fast heating rates can be obtained by microwave energy Jet molding on an automatic basis could easily become one of the faster means of molding thermosetting material

Microwave energy piped to numerous press positions from one central generator may be the future answer to many a molder's present problems Central generators supplying many operating positions have not proved too satisfactory at conventional frequencies because of the many electrical problems encountered



Courtesy Raytheon Manufacturing Company

Microwaves cooked this steak dinner in just 35 seconds

For plastics and synthetic materials there is a rapidly growing demand for bonding or sewing of sheet material such as the vinylidene chloride materials Here again conventional dielectric heating at low frequencies is relatively slow and microwave energy properly applied may be the answer It may be possible to bond such sheet materials at a high rate with simple handling equipment Using presently available flexible waveguides, such a bonding operation could result in a flexible hose from whose open end microwave power would emerge like water from a garden hose, and be equally controllable

MICROWAVE STOVE — Similarly, a divergent taper at the end of the hose could be attached to provide a horn-shaped affair that would spray microwave energy over a larger area Fittings of this latter type are already in use The Radarange made by Raytheon utilizes this type of construction The flared portion forms a "horn" antenna fed by a magnetron tube mounted above the apex of the horn Microwave energy radiates downward, out of the flared portion, and into the food below

The commercial model Radarange was engineered and designed primarily for extremely rapid cooking of foods served by the quick-lunch counter and the drive-in type of restaurant

Use of Radarange results in a reduction of food handling, elimination of waste, and increase of over-all economy It cooks a hot dog in roll in 15 seconds, pre-cooked beef steak in roll in 15 seconds, grilled ham and cheese in 18 seconds, raw hamburger with onion in roll in 35 seconds, and it bakes gingerbread from batter in 26 seconds, corn muffins and other types of cupcakes in 26 seconds

The sandwiches can be at refrigerated temperature going into the machine and at approximately 200 degrees, Fahrenheit, coming out Most meats and vegetables can be cooked in approximately two minutes.

Input power requirement is 4½ kilowatts, this power being supplied at 115 volts, 60 cycles, A C at 40 to 45 amperes current consumption or 230 volts, 60 cycles A C at 20 to 22½ amperes current consumption. Basically, the input line voltage is stepped up by a transformer to 4000 volts, rectified, and fed to the magnetron oscillator.

Radio-frequency energy output of this tube is oscillating at a frequency of 3,000,000,000 cycles per second, a microwave wavelength of 0.1 meter. No heat whatsoever is generated until the energy is transmitted into the food, whereupon the molecules of the food itself rotate in synchronism with the radio-frequency energy. The friction caused by the agitation of the molecules generates the heat internally in the food itself just as is done in conventional dielectric heating.

Factories and other industrial plants that maintain lunchrooms for employees could use this type of quick cooking service and save on kitchen space and preparation time in the handling of food. Hot meals in aircraft may soon be commonplace using a lightweight version of the Radarange. This model is designed to defrost and heat a pre-cooked eight-ounce meal, consisting of four ounces of meat, two ounces of potatoes, and two ounces of a vegetable, in approximately one minute. The temperature of the food in the frozen state is 10 degrees, Fahrenheit, and is 170 degrees, Fahrenheit, at the end of the time interval. The input power requirement is 5000 watts per minute per meal.

With actual microwave heating equipment now on the market for the restaurant trade and with engineers seriously considering the industrial possibilities of this unique method wherein the radio waves themselves produce heat, it can safely be said that the microwaves of war-time radar fame are definitely finding their place in industry.

* * *

ELECTRONIC DRIVE

Provides Stepless Speed Control for Printing Presses

MAKING its debut at the *Philadelphia Inquirer*, an electronic drive is being put on 61 rotogravure presses and 44 newspaper press units at the new plant of the newspaper.

Except for the D C drive motors, the control equipment has no moving parts. All the current for controlling the speed of these motors is handled by huge all-metal electronic tubes called ignitrons, that can be turned on and off gradually with a variable resistor no larger than the volume control on a radio set.

With this new General Electric drive, especially adapted for use with high-speed rotary web presses, adjustable voltage is supplied to adjustable-speed D C drive motors which may be mounted coaxially with the main shaft of the press. Stepless speed control—including jogging, slow threading speed, acceleration, deceleration, and dynamic braking—can be achieved from conventional push-button stations on the presses.

SEE-SAW BED

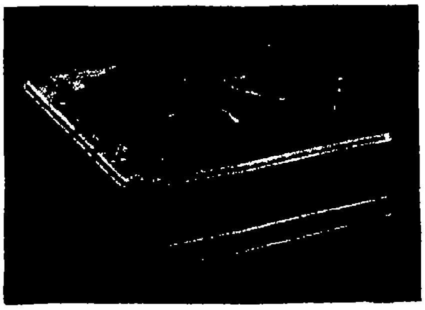
Electric Drive Aids Polio Victims' Respiration

TO HELP in treating the after-effects of polio, a bed which is mounted on a pivoted frame, driven by a General Electric Thymo-trol drive, see-saws in rhythm with the patient's normal breathing. By turning a small knob an attendant can regulate the speed of the driving motor. In addition to aiding polio victim's respiration, the bed has other uses in treating respiratory and circulatory diseases.

TALKING LETTERS

Recorded on Coated Paper Disks

DISKS of paper coated with a magnetic material serve as the recording blanks for a new Mail-A-Voice sound recorder and reproducer. There are no grooves on the paper but when a record is made or played back a grooved spiral plate is placed on the turntable to guide the magnetic tone arm. This electronic recorder-reproducer, made by The Brush Development Company, uses paper disks coated with a magnetic material. During recording, the coating on a disk is magnetized to varying strengths proportional to the sound signals fed in, and during playback the magnetic variations cause sound signal voltages to be induced in the tone arm.

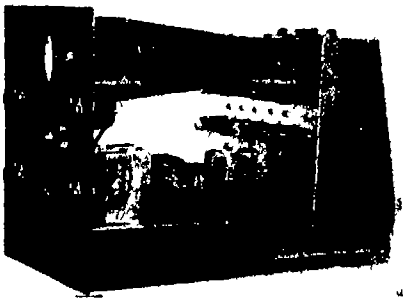


Magnetic disk coating records sound

METAL IDENTIFIER

Unit Operated by Unskilled Personnel

CALLED the Ferrograph, a new electronic instrument provides a simple means for relatively unskilled personnel to identify or compare iron and steel rods or bars at a rapid rate. The sample is made the core of a two-winding transformer. The voltages across the windings are amplified and applied to a cathode-ray tube used for direct indication of the results. Patterns obtained on the screen for samples of unknown composition are compared with patterns for known samples to obtain positive identification.



Electronic "brain" identifies metals

RIVER-BOAT RADAR

Permits Shipping Movement In Fog-Bound Waters

RADAR for river towboat traffic has been given winter tests jointly by the Ashland Oil and Refining Company, the United States Coast Guard, and the Sperry Gyroscope Company. For years, heavy fogs on the Ohio and Mississippi Rivers have forced river pilots to stay tied to the bank awaiting clearing weather. Now, with the aid of radar these long and expensive delays can be eliminated. Even though the visibility be reduced to 20 or 30 feet, a thousand-foot barge-string may now proceed on its way in safety.

Captain Kent Booth, master of the Tri-State towboat used in the tests said the Sperry radar showed clearly the shore line of the river approaching craft which were beyond view, boats tied to the bank, bridges and power lines crossing the river, locks and dams, and other objects.

Coats Make

In a Great Many Instances, the Qualities of the Plastics Coating, Rather Than Those of the Base Material, Are Responsible for a Product's Serviceability

By CHARLES A. BRESKIN
Editor Modern Plastics

• LOOKING AHEAD •

Service life of many metal parts greatly extended by corrosion-preventive plastics finishes. Grease-, oil-, and water-resistant papers in specialized packaging jobs. More durable, more sanitary finishes for kitchen, laboratory, and hospital furniture and fixtures. Safer food handling with tanks, boilers, and cans lined with tasteless, odorless plastics.

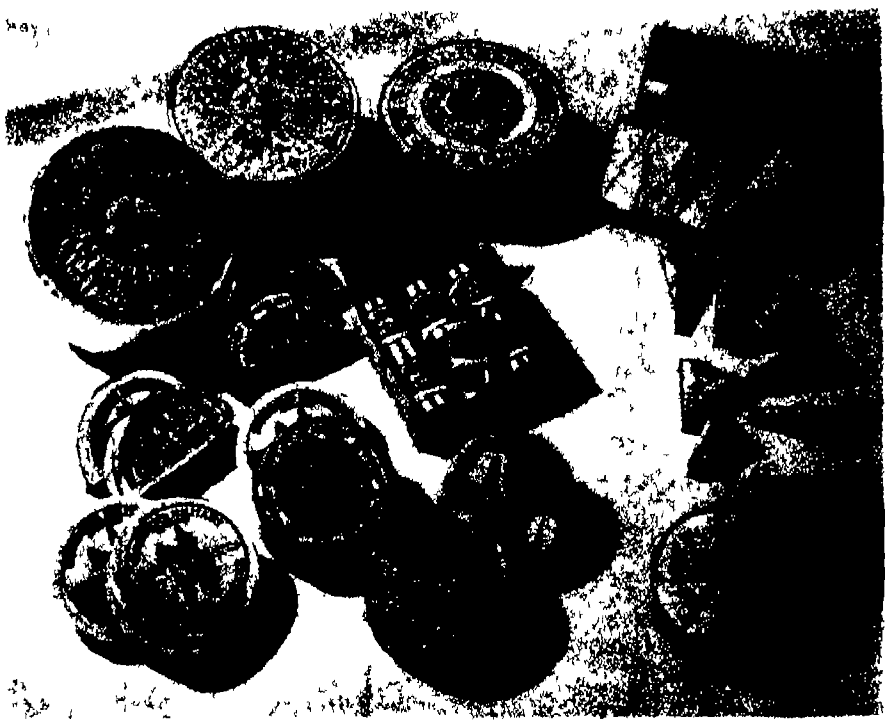
To THE layman, the word "coating" connotes a superficial finish which, at best, enhances the appearance of a product and protects the material of which it is fabricated. The modern manufacturer, however has proved that the correct plastics coat can have equal or greater importance than the cloth, paper, leather, or metal base which it covers. In some instances, it is the coating that imparts to the product the qualities that make it usable and salable, while the structural material serves merely as a frame or base for the surface.

Cited here are some case histories of coats that make the product. A Canadian manufacturer is marketing an attractive table with a durable top resistant to heat, moisture, and stains—a table designed for rough restaurant service. Basically, the laminated lignin material, derived from paper mill waste, would not be suitable for this application, but a thin coating of melamine provides the necessary surface characteristics. Thus it is possible to capitalize on the structural strength of the economical lignin in a field it could not otherwise reach.

The average paper loses its strength when wet, and in some applications this is a fatal weakness. Obviously, it is imperative that toweling, frozen food packages, blueprint paper, paper diapers, bags, and wrapping paper retain their strength when subjected to moisture. Without some means of imparting this resistance to paper all the uses mentioned would be difficult or impossible, and markets would be lost to competing materials. An effective answer to the problem was the use of urea and melamine resins. These resins either can be incorporated into the beater stock in the manufacture of the paper, or can be used to impregnate the paper after its manufacture. In either case, the result is a high wet-strength paper. Again the coat made the product.

When available supplies of leather began to fall behind consumer demand, manufacturers of shoes, luggage, handbags, and similar products found it necessary to utilize every scrap of material they could obtain. The difficulty was that much of this leather was inferior in quality to the grades commonly used for these purposes. Surface blemishes are major handicaps in the fashion field, and the manufacturer had to find some way to give imperfect leather the flawless appearance his customers demand. He found that acrylic resin coatings level the surface and minimize surface defects. The acrylic film forms by coagulation and the deposit is heavier in the lower spots of the leather. The result is a smooth, even surface and a ready entry to the fashion market which otherwise would be closed to these marred materials.

Technical advancement in coat-



Courtesy Bakelite Corporation

Vinyl coat on metal foil insures against odor transference, renders packages resistant to chemicals present in dairy products, and adds flexibility, permitting packages to retain protective qualities through many unwrappings

The Product

Courtesy Aluminum Company of America

These aluminum spinning buckets, designed for use by the rayon industry, are made corrosion resistant by the application of a phenol formaldehyde coating

ings during the past ten years can be attributed both to the extreme severity of the conditions to which many finished articles were subjected during World War II, and to the critical condition or actual unavailability of a great many of the raw materials required to produce most of the durable finishes then in use Knowledge and experience acquired in development of protective coatings to meet these conditions are being applied toward production of similar coatings for industrial, commercial, and domestic applications The technical background thus gained has been an asset in the development of decorative as well as functional coatings of all types

HOW COATS ARE APPLIED — Coatings are applied in four ways in solution, as melts, as pastes, or as films

Coatings in solution These can be applied by simple brush, dip, or spray processes, and depend either upon evaporation of the solvent to leave the required deposit of resin, or upon cure of the resin by heat

Coatings as hot melts Hot melts are applied by dipping or spraying These coatings are thermoplastic (can be re-softened by the application of heat) and require only cooling to harden

Coatings as paste Pastes are spread by means of a doctor blade and subsequently calendered (run between two rollers that squeeze out the excess coating material)

Coatings as films In this form coatings are applied by calendering frequently in the machinery in which they are produced In some cases, films are first cast on paper or other receiving medium and subsequently transferred to their final backing

In discussing the various important coatings applications, this article will be confined to metals, paper, and leather, leaving the fields of fabric and wood coatings for separate attention in a later article

In no other application has coating won more complete acceptance than in metals for home use A refrigerator or stove without the customary durable, sanitary, attractive coating probably would be unacceptable to the housewife Less publicized, but equally important, is a wide range of industrial uses

The type of surface coating to be used on metal is determined not only by the type of metal, but also by service conditions to be encountered For metal furniture and fixtures, instruments, and machinery which are to be used where there are no serious corrosion problems surface coatings may be comparatively simple one- or two-coat systems Most of these are baked or are fast-drying lacquers Many special finishes, such as wrinkle coatings, may be used for decorative effects

When metals are to be used under more corrosive atmospheric conditions, subjected to galvanic or electrolytic corrosion, or brought into contact with foods, drugs, or chemicals, more elaborate finishing systems are necessary Such systems usually include 1) passivation of the surface by chemical pretreatment, 2) use of primers containing inhibitive pigments, and 3) sealing the surface with an impervious coating

The familiar refrigerator coating is likely to be melamine resin coating which has superior resistance to abrasion, water, and chemicals, and to discoloration on exposure to light This last property makes it particularly valuable as a finish for automobiles Another plastics which lends itself to refrigerator coatings is silicone resin but, at present, cost considerations limit its use in household equipment Instead, it is being used in products that require its excellent electrical insulation properties—on ceramic insulators and in conjunction with glass fabric

The electrical insulation qualities of several plastics coatings open a broad field for industrial uses. For example all types of coils are coated with phenolic oil-soluble resins Ethyl cellulose is used to protect cables Polyethylene also has good electrical properties

AIDS FOOD HANDLING—Coatings make another valuable contribution in food handling and packaging For example, phenolic baking resins are used to protect tanks and other food and beverage equipment The chemical inertness, non-toxicity, and lack of odor and taste make vinyl resins ideal coatings for interiors of containers for beer, other beverages, and foods The acrylic resins also have high resistance to water, alcohol, vegetable acids, mineral oils, and chemical fumes

To protect the finish of a product during plant handling and processing, manufacturers frequently apply a temporary coating which can be stripped off either when the finished product comes off the assembly line or when it is taken out of stock for delivery to dealer or customer This protection is afforded by ethyl cellulose, acrylic, polyvinylidene chloride, or vinyl chloride

The shipbuilder, concerned with protecting metal surfaces against the corrosive effects of salt water, finds

Courtesy Bakelite Corporation

A vinyl strip coating, applied with an ordinary spray gun, provides excellent packaging for the electric fan

a valuable aid in dispersion-type phenolic coating resins with their high resistance to the passage of water and their remarkable exterior durability, and in coumorone-indene resins The high heat-resistance of these last finishes makes them suitable also for the coating of steam pipes and flues

ON PAPER — In the past, coating of paper has been achieved mainly with the aid of clays, asphalts, waxes and natural resins Synthetic materials have been introduced largely as modifying agents to improve the properties of these cheap basic materials Since price considerations are exceedingly important in the paper industry, however the application of many otherwise desirable plastics is limited

In general, resinous coatings can be formulated to give gloss, scuff-proofness, tear-resistance, improved packing, and heat-sealing properties With the aid of pigments, dyes or other additives, or by means of embossing rolls or dies, novel and decorative effects may be obtained Plastics coatings have greatly improved this quality of paper Some of the widely used resin coatings and the properties they impart to the paper are described in the following paragraphs

Polyvinyl alcohol has a high resistance to oil, gasoline, and certain other solvents, and gives a grease-proof coating Since it is water-soluble, however, it cannot be used for applications that are intended for wet and humid climates

Vinyl esters and vinyl acetal resins, with a ready resistance to oils and chemicals, are used in grease-proof paper for food wrapping and in liners for bottle caps and gaskets

Polyvinyl chloride as a coating for paper imparts water- and grease-resistance and is much used as a coating for shipping containers

Cellulose nitrate improves the durability and appearance of paper, but has the disadvantage of flammability

Ethyl cellulose is used to coat the insides of food and medicinal packages, because of its resistance to alkalis and also for its non-toxic properties

Polyethylene is also used as a coating for paper that comes in contact with foods and medicinals It gives toughness, good impact resistance, low water vapor transmission, low water absorption, chemical inertness, and non-toxicity

Coumorone-indene resins are used to impregnate or laminate heavy paper for use as building paper It is also used for bags holding chemicals and fertilizers

COATING LEATHER — A coating for leather must possess special characteristics It must be adhesive —able to cling tenaciously to the fibers of the leather in spite of changes in moisture content or temperature It must be flexible—as pliable as leather itself—so that it can bend and stretch with the leather without cracking or losing adhesion It must be durable—able to hold up throughout the severe conditions of use to which leather is often subjected Finally, it must be attractive in appearance

Two of the newest plastics coatings for leather are the silicones and emulsions of thermoplastic resins The two silicone fluid preparations used in dressing leather not only keep the leather soft and flexible, but provide a water-repellent finish for the skins The emulsions of thermoplastic resins provide an attractive sheen on the leather and form a continuous surface film which is tough and water-resistant They are capable of binding pigments securely to the leather

Among the materials used for sizing and bonding leather are vinyl resins, combinations of vinyls and phenolics, formulations of butadiene-acrylonitrile and phenolic resins, and liquid organic polysulfides Urea resins in conjunction with treated oils have also been used to coat leathers

The soft and tacky types of resin are utilized for binding the major portion of the pigments to leather in the bottom or lower coat Dryer and harder types are used in the upper or top coats

Plastics also form the basis for artificial leathers—but that is another story

POLYETHYLENE BAGS

Insure Maximum Freshness For Frozen Foods

What may prove to be an important use for polyethylene is as a packaging material for foods Traver Corporation is now fabricating Bakelite polyethylene into bags for use in packing quick-frozen fowl, fish, and meat so that the food can go from packer to consumer without being exposed to the air The advantage of polyethylene for this application is that it is odorless tasteless, non-toxic, and resistant to fats and brines

RESIN ADHESIVE

Makes Laminating Complex Patterns Easy, Inexpensive

Woodworkers were once restrained in their creatings by the limitations of their medium Many scrolls and curves were too wasteful of time and effort when cut from solid blocks or timbers But there are no such limitations when fabricators take advantage of the possibilities of laying up of thin strips of wood over light, inexpensive forms and laminating the strips with Urac 185 resin adhesive

Waste less curves in a wooden gate

COATED YARN

Makes Easily Cleaned Nurses' Caps

Plastics coated yarn in nurses' caps facilitates neatness and cleanliness when time is at a premium When Plexon coated yarn is used as the material in nurses' caps, it is necessary only to wipe the cap with a damp cloth to remove all dirt and stain Furthermore, this fabric is impervious to most acids in addition to dirt and grease Merland Manufacturing Company is now making these caps for Angelica Jacket Company.

• LOOKING AHEAD •

Harder, more resistant paints and varnishes made from less expensive materials. Bacteria-killing air conditioning system to reduce industrial absenteeism. Commercially practical production of synthetic rubber from agricultural wastes

Courtesy Woburn Degreasing Company of New Jersey

Huge pressure splitter, using chemicals and heat, separates glycerine from oils and fats

Glycerine and Glycols Gain Ground

By HOWARD C. E. JOHNSON, Ph.D.

Chemical Editor *Chemical Industries*

Polyhydric Alcohols, Soon to Be Made Greatly More Abundant by the Construction of New Manufacturing Facilities, Are Rapidly Increasing in Industrial Importance. They are Used in Such Diversified Products as Dehumidification Agents, Resins, and Insect Repellents

Versatile glycerine, familiar to the average man only as an ingredient of cough syrup and as an anti-freeze for his automobile, is an important raw material to the industrial chemist. He sees in it the basis for a score or more of useful products.

Called the "sweet principle of oils" by Karl Wilhelm Scheele who discovered it in 1779, glycerine has since that time been obtained as a by-product of soap manufacture. Now, however, the Shell Chemical Company is erecting a $10,000,000 plant to make it from propylene, a constituent of natural gas.

In this process, propylene, which occurs to some extent in natural gas, or can be obtained by cracking petroleum, is treated with chlorine at a high temperature to form allyl chloride. This, in turn, can be treated with chlorine in water-solution to form the chlorhydrin. The latter material is hydrolyzed to allyl alcohol, which can then be transformed into glycerine by the same procedure. Perhaps the most important feature of this process is that the raw materials—petroleum, salt and water—are abundant.

Another synthetic process, patented by E. I. du Pont de Nemours and Company but reported to be not yet in operation, involves the reaction of carbon monoxide with formaldehyde to produce glycolic acid. This in turn is used in another reaction to produce a formaldehyde derivative of glycerine from which glycerine itself is readily produced. The only raw materials necessary are carbon monoxide and hydrogen, a mixture readily obtained by passing steam over red-hot coke.

MEET THE FAMILY — Glycerine, a chemical compound which contains three hydroxyl groups, is the foremost member of the glycol or polvhydric alcohol family which consists of those compounds made up of two or more hydroxyl groups. A great many of these compounds have become exceedingly important in recent years in a large number of industries. Glycerine, for example, is a chief constituent of alkyd resins, made by the reaction of glycerine with phthalic anhydride, maleic anhydride, and other dibasic acids In 1944, production of these resins exceeded 100,000,000 pounds

The second most important member of this family is ethylene glycol The Carbide and Carbon Chemicals Corporation makes this material by oxidizing ethylene with air The Dow Chemical Company makes it by a different process involving the use of chlorine and ethylene Ethylene glycol has now largely replaced glycerine as an anti-freeze for automobile radiators and in many pursuit planes, engines are cooled by glycol rather than water or air Certain types of dynamite are made with glycol dinitrate instead of nitroglycerine

Among the foremost derivatives of ethylene glycol are the so-called Cellosolves and Carbitols These ethers of ethylene glycol and diethylene glycol, respectively, are valuable because they are excellent solvents for cellulose esters and have thereby contributed to the growth of the lacquer industry Since they can be used with both water and organic solvents, they are widely employed for coupling immiscible liquids in preparing soluble oils, cutting oils, insecticides, dry-cleaning fluids, soaps, and the like They are also used in shock absorbers, brakes, aircraft landing gears, and other hydraulic systems

Other glycols similar to ethylene glycol are propylene glycol, dipropylene glycol, and diethylene glycol The latter is widely used in the textile industry in dyeing and printing operations, and one cigarette company exploits the fact that its product is kept moist with diethylene glycol instead of glycerine, claiming that it does not give the irritating material, acrolein, upon burning

REDUCES ABSENTEEISM—A more complicated glycol, triethylene glycol, is helping to cut down colds and other infectious diseases It has been discovered that small amounts dispersed in the air kill air-borne bacteria The material is used as a dehumidifying agent in air-conditioning systems, and the small amount of the glycol vaporized during operation is reported to knock out cold germs In two identical buildings at the Lockheed Aircraft Corporation, operated during a complete winter, one with and one without glycol vaporization, absenteeism in the glycol-treated plant was only half that of the other

Ethylene glycol is another one of the materials which has been found to be an excellent insect repellent Either in liquid form or incorporated in a cosmetic cream, it repels mosquitoes, biting flies, gnats, chiggers, and fleas, and can be produced as a dual purpose sun-tan and repellent cream for beach use

Diethylene and triethylene glycols might be considered the dimer and trimer, respectively of ethylene glycol Higher polymers of ethylene glycol, ranging in molecular weight from 200 to several thousand, are also manufactured for industrial purposes Those with average molecular weights ranging from 200 to 700 are liquids, those above 1000 are wax-like solids, some like petroleum jelly, others like paraffin One of their many uses is a water-soluble base for cosmetic creams

Wiping finished rubber tubing with glycerine helps prevent drying out

The liquid polymers are good plasticizers and dispersants for casein and gelatin compositions, glues, cork, and special printing inks The textile industry uses them as water-soluble lubricants in warp sizes, conditioners, and finishing agents for textile yarns Esterification with dibasic acids gives alkyd-type resins, with fatty acids, emulsifying agents and detergents are produced

ALCOHOLS FROM GLUCOSE — Ordinary glucose can be converted into sugar alcohols by an electrolytic process currently used by the Atlas Powder Company By changing the reaction conditions, either sorbitol or mannitol may be obtained, which have the same chemical formula as the sugar alcohols, but differ slightly in their structure and properties They are really double molecules of glycerine, and indeed may be used as replacements for glycerine in many formulations Sorbitol, like glycerine, absorbs moisture from the air It is used as a softener, therefore, in such diverse products as candy and glue Reaction with fatty acids gives excellent emulsifying agents which are unaffected by the salts present in hard water Sorbitol is also used in the paint and varnish industry to prepare drying oils and synthetic resins

The jaw-breaking name of pentaerythritol is given to an interesting polyhydric compound made from acetaldehyde and formaldehyde Tons of this material were produced during the war as the starting material for pentaerythritol tetranitrate, a superior explosive Although this application is minor now, large amounts are still being made by Hercules Powder Company, Heyden Chemical Corporation, and Trojan Powder Company as a raw material for synthetic resins Production of these in 1944 exceeded 12,000,000 pounds

Varnish resins made by Hercules from rosin and pentaerythritol, called Pentalyns, are claimed to be superior to rosin-glycerine resins in that they have a higher melting point and are more resistant to heat and oxidation. These improved properties are ascribed to the symmetry

Courtesy Woburn Chemical Company of New Jersey

Pump of a vacuum evaporator where glycerine and water are separated

of the pentaerythritol molecule It is a general rule that the more symmetrical a molecule is, the higher is its melting point and the greater its stability It is claimed that pentaerythritol resins permit the use of the cheaper linseed and dehydrated castor oils rather than the expensive tung oil in varnishes

FARM WASTE TO RUBBER — A special kind of fermentation that transforms carbohydrates into butylene glycol has been reported by the National Research Council of Canada It is believed that the process has not yet been worked out on a commercial scale, but agriculturists are showing great interest The glycol can be converted with ease into butadiene, major constituent of synthetic rubber, and this process would provide a route to synthetic rubber from agricultural wastes

It is hard to imagine an industry untouched by the variegated products into which the glycols and polyhydric compounds enter If industry had to depend upon the glycerin present in natural fats and oils, scarce the world over, prospects for a wide extension of its uses would be dim indeed Fortunately processes based on petroleum hydrocarbons are getting under way There are enough glycerin and glycols potentially available from petroleum, air, and salt to give us varnish resins, synthetic detergents, anti-freeze compounds, insect repellents, and cosmetic bases, for some time to come

● ● ●

VINYL ETHERS

Serve as Plasticizers, Adhesives, and Pharmaceuticals

Latest additions to the vinyl family—of which vinyl acetate and vinyl chloride are the most illustrious to date—are the vinyl ethers, six of which have already appeared methyl, ethyl, isopropyl, *n*-butyl, isobutyl, and 2-ethylhexyl

Like other vinyl compounds, these ethers can be polymerized to useful resins The characteristics of the polymers may be varied at will, depending on which ether is used and the conditions of reaction, giving a range from liquids to rubbery solids to waxlike balsams The polyvinyl ethers are useful as adhesives, plasticizers, coatings, and lubricants

As adhesives they are more stable to light and storage than rubber, and they have been used for surgical tapes, envelope seals, laminating glass, sealing cellophane and metal foils, and cementing other materials to glass

The new vinyls have been used as plasticizers for nitrocellulose, synthetic rubbers and other resins, in synthetic polishing waxes, and for impregnating textiles and paper

The monomers are interesting, too as possible intermediates for pharmaceuticals, rubber chemicals, lubricating oil additives, and a host of other synthetic organic materials Ethyl vinyl ether is an anesthetic similar to ordinary ether

General Aniline and Film Corporation is manufacturing methyl ethyl, *n*-butyl, and isobutyl vinyl ethers by processes based on acetylene

Carbide and Carbon Chemicals Corporation are offering the isopropyl and 2-ethylhexyl vinyl ethers, as well as the ethyl, produced by presumably different methods

AGRICULTURAL FUNGICIDE

Forms Rubber-Like Film, Does Not Wash Off Plants

Potentially important, a new agricultural chemical which has polyethylene polysulfide, derived from petroleum and sulfur, as a basic material has been developed by the B F Goodrich Chemical Company It is one of a group known by the trade name Good-Rite and is now ready for commercial application following several years of research development and testing

This latex-like material (see also page 3, January 1947 Scientific American) is not only an effective fungicide when used alone, but an outstanding assistant to insecticides and other fungicides Its adhesive quality holds the chemicals so that they cannot be washed away after application by rain, dew, or other moisture, thus providing maximum killing action against blights, diseases, insects, and pests of various kinds

Supplied as a latex closely resembling dispersions of many synthetic rubbers now on the market both in appearance and physical characteristics, the chemical solution, when diluted with water, can be used with standard spraying equipment and by conventional methods After drying the material forms a microscopic web that can be removed only by scraping, decomposition of the chemical materials, or expansion by growth. The film stretches to accommodate some growth after it has dried With applications discontinued six weeks before harvest, no odor, taste, or other undesirable evidence of the spray remains on fruit or vegetable to create any problem in the preparation of the foods for market

Used alone as a fungicide the new chemical has proved capable of controlling most of the fungi which cause extensive losses on fruit trees, including apple scab Employed in conjunction with other fungicides pesticides, and insecticides, as a carrier and adhesive, the Good-Rite product has shown excellent results

Deep Draws with HOT MAGNESIUM

When Raised to the Proper Temperature, Magnesium Develops Singular Workability With it, a Fabricator is Able to Accomplish in One Draw What Would Require a Series of Operations With Many Other Metals

By FRED P PETERS
Editor in Chief *Materials & Methods*

ALTHOUGH magnesium is known to be the easiest of the commercial metals to machine, the readiness with which it can be hot-drawn is not so generally understood A few fabricators, however, have taken advantage of magnesium's hot workability, developed techniques to suit the process to the mass production of normally "difficult" shapes and are capitalizing on the demand for light-weight products of rather large size

The Brooks and Perkins company has been one of the pioneers in production of deep-drawn parts of magnesium alloys, and the information in this article is based on their experience During the war this company cut its deep-drawing eyeteeth on radar housings, aircraft dorsal fins, supercharger oxygen bottles, and so on—all hot-drawn in magnesium alloy Since the war, the company has been one of the chief fabricators of the ubiquitous magnesium griddle, which not only aids the housewife and amateur chef in whipping up a quick and evenly cooked batch of wheatcakes or fried eggs, but also effectively demonstrates the non-flammability of solid magnesium Others among their post-war products are discussed below

The factor that in the past had retarded the commercial development of deep-drawn magnesium products was the difficulty in cold-drawing magnesium and its alloys—forming or stamping them at room temperatures The crystal structure of magnesium makes it one of those metals that are prone to crack or break under working stresses at temperatures up to, say, 400 degrees, Fahrenheit But at temperatures between 450 degrees, Fahrenheit, and 600 degrees, Fahrenheit, it is possible to do with magnesium in a single draw what would require up to three drawing operations in steel, brass, or aluminum

Deep-drawing of magnesium, of course, does have its technical problems, which such fabricators as Brooks and Perkins have learned to control within economic limits The drawing dies are heated, using either electric strip heaters or open gas flames, die punch, and the work to be drawn must be heated to the proper temperatures In designing both the part and the steel dies to form it, allowance must be made for thermal expansion effects, and for distortion during heating Suitable lubricants must be used on

Courtesy Brooks and Perkins

Pan of the magnesium wheelbarrow was formed in a single draw

• LOOKING AHEAD •

More and more manufacturers realizing the advantages of magnesium's workability An avalanche of new products

blanks and dies Press pressures and speeds must be closely regulated

PRICE COMPARISONS — With all this—and despite the somewhat higher price per pound of rolled sheet magnesium alloys in comparison with other metals—their difference in weight and their lower fabrication costs (only one draw, with elimination of intermediate anneals) are enough to make deep-drawn magnesium parts comparable in price to the same products made of other metals

In general, any design which can be drawn from sheet steel, aluminum copper, or brass can be successfully drawn from magnesium Indeed, some parts that are difficult or impossible to draw in other metals are readily formed out of magnesium A good example are the top corners (roof corners) of large buses, which in the past have been partly drawn from sheet steel and then finished by power hammering to shape They are now completely drawn in one operation from magnesium alloy, with a noticeable saving in labor cost

Amenable designs are numerous Hemispherical or cylindrical shapes have been drawn to a depth of about twice their diameters, in one draw Rectangular box shapes have been drawn to a maximum depth of 1½ to 1¾ times the narrower width in a single draw These are at present the approximate limits that are commercially feasible, using a single draw

The magnesium alloys most commonly used are Dow M or American Magnesium Corporation 3S, containing 1 5 percent manganese, Dow FS-1 or AMC 52S containing 3 percent aluminum and 1 percent zinc, and Dow JS-1 or AMC 54S, containing 5 percent aluminum and 1 percent zinc Alloy M (AMC 3S) is lowest in price, with the best deep-drawing characteristics If higher strength and not much weldability are needed, FS-1 (AMC 52S) is used For highest mechanical properties and good weldability, JS-1 (AMC 54S) is the usual choice

Courtesy Warren McArthur Corporation

Magnesium pans for aircraft seats are deep drawn in electrically heated dies

SPECIFIC APPLICATIONS — Aside from the established uses of deep-drawn magnesium parts for aircraft components, a number of other applications have been developed in the past two years The best-known are the magnesium griddle, the magnesium wheelbarrow, and the magnesium canoe, other important applications include radio and radar cases, portable tool housings, business machine cases vacuum cleaner parts, camera and projector housings, and, most recently, an oil filter for an aircraft de-icing system

In one instance, a radar computor case, the case and cover were each made as a single draw, after which the holes were blanked A strip of thin sheet magnesium was spot welded at the top of the box to form the flange for the cover Threaded tubes and clips were welded in by argon-shielded arc welding A black crackle finish baked on is used for this product In general there is no limit to the number and types of paint, enamel, and lacquer finishes that are successful on magnesium alloys

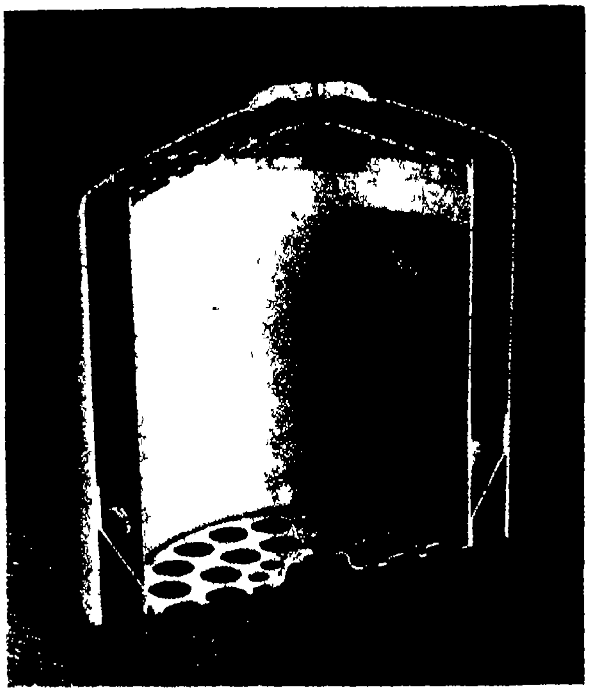
For the dorsal fin on the Republic P-47 Thunderbolt, previously mentioned, 0 040-inch thick sheet was used, with the radius at the bottom of the drawn crease only ⅛ inch Although the fin is about five feet long, it is so light that a girl can hold it without effort

The oil filter case was formerly produced from aluminum sheet with several components made by spinning The product was redesigned and made as a drawn-magnesium part not only to save weight but also to reduce production cost When made of aluminum spinnings the case weighed three and one half pounds, as now produced the case weighs only two pounds, six ounces, a weight saving of 32 percent

There are several parts to this "case," which really functions as a combined housing and oil separator, the main ones (all of deep-drawn magnesium) being an outside container, an inner shell and a combined spacer and perforated inner section The outside container, 8-3/16 inches in outer diameter, is made in one draw, which includes the forming of 12 stiffening ribs on the bottom and the punching of a hole for a through-bolt The inner shell, also drawn to a 10-inch depth in one operation, is formed as a can the bottom is later cut off and the extra material at the top removed to give the desired cylinder The piece from which the spacer and inner section are formed also involves a single draw, to a depth of six inches

Other items, now being produced as magnesium drawings for weight-saving purposes, are even more dramatic A 16-foot canoe, full-size in every respect, has been produced with a weight of slightly under 55 pounds It comprises four deep-drawn magnesium sections, each eight feet long, drawn in a hydraulic press of 950 tons capacity at 625 degrees, Fahrenheit The sheet used is alloy M, 0 051 inch thick

WELDED AND RIVETED — After drawing, the pieces are trimmed, and the sections welded together to form two longitudinal half-sections These are then riveted to an



Cutaway view shows the deep drawn magnesium parts which comprise an oil separator assembly

Courtesy Brooks and Perkins

extruded magnesium keel strip Other parts—gunwhales, thwarts and so forth—are also made of magnesium

Like the canoe, the magnesium wheelbarrow is an interesting example of a large size press-formed magnesium product and shares with it all the problems of special shape and irregular (not rectangular or cylindrical) contour The sloping sides of the wheelbarrow are difficult to draw without wrinkling, and the variation in slope for the different sides presented extra problems

The wheelbarrow pan is formed from 0 072-inch alloy M sheet, held at 650 degrees, Fahrenheit, during drawing After trimming the pan is beaded around the upper edge and the result is a full-size piece of extreme lightness and with ample strength and rigidity for this service The handles of the wheelbarrow are made of magnesium alloy tubing and the legs of extruded flat bar stock The wheelbarrow is very simply assembled by bolting

The total weight of the completed wheelbarrow is only 12 pounds achieved through the use of magnesium alloys in virtually the entire construction The axle bolt, rubber-tired wheel, rivets, and assembly bolts are the only important exceptions

For these and many other products, the use of magnesium alloys, deep-drawn in one operation at elevated temperatures, has produced noteworthy benefits in lightness of the finished product, mass-producibility and in some cases, lowered cost It is true that the need to carry out the drawing at elevated temperatures does introduce additional complications but it should also be remembered that at those temperatures more can be accomplished with magnesium in one operation than with other metals in several operations at room temperatures

One manufacturer has stated flatly that those who have become familiar with the deep drawing of magnesium alloys would rather work them than other metals Once this state of mind becomes wide-spread, watch for an avalanche of products like the magnesium griddle, wheelbarrow, and canoe

* * *

ALUMINUM WELDED

By Processes Using Air, Heat, and Dies

Welding and forming aluminum sheet by a novel method was accomplished by the Germans during the war in the manufacture of aircraft radiators In this operation, sheets of aluminum are virtually melted together between gas heated dies that are closed under pressure When the dies are nearly closed compressed air is injected between the sheets to blow open the areas between the rows of welds, in order to form passageways conforming to the design of the dies

The working temperature of the press welder is 842 degrees, Fahrenheit The pressure of the air cushion in the machine table is 36 8 to 51 5 pounds per square inch, and the pressure of air used to blow open the sheets is 265 to 350 pounds per square inch The air pressures selected depend upon the physical properties of the material, and only after experimentation can another material be employed

PRINTED SILVER

Replaces Copper Wire In Electrical Circuits

Relatively large volumes of copper have been replaced with infinitesimal amounts of printed silver in the circuits of the VT fuse And the same process is now being applied in several other products

The silver is laid down on a steatite base as a paste of either powdered silver or silver oxides, with appropriate binders and solvents to hold the conductor in suspension The binder is burned off in a furnace at 1300 to 1500 degrees, Fahrenheit, following the printing of the circuit, and the silver conductor is left adhering to the plate, just as the pigment in ordinary printing ink remains after its vehicle is removed by drying

NON-CORROSIVE COAT

With Zinc Base Found Superior to Tin

Developed as an answer to the shortage of tin, a zinc-base finish for metal parts has a bright luster resembling that of chromium and corrosion resistance claimed to be greater than that of conventional tin coatings

Known as Anozinc, and developed by United Chromium, Inc, the new electrodeposited coating is now being used on refrigerator shelves Before adopting it, the refrigerator manufacturers investigated at least 100 different metallic and synthetic coatings, finally settling on Anozinc as providing the desired combination of corrosion resistance, bright metallic appearance, non-toxicity, and hardness

Several variations of the process are available In general, it comprises electroplating a zinc coating on the steel, then anodizing to produce a zinc chromate product on the surface, and finishing with a special clear synthetic lacquer

At least 75 percent of the refrigerator shelves processed in the last year have been finished with this treatment Black Anozinc finishes have also been used on zinc plated aircraft propeller blades, while the yellow coating has been used very successfully on zinc-plated wire screen cloth

Micro-Hardness Testing

New Knowledge of Steels of Definite Hardness and Toughness is Being Gained Through the Application of Techniques Which Measure Characteristics of a Single Grain of Metal

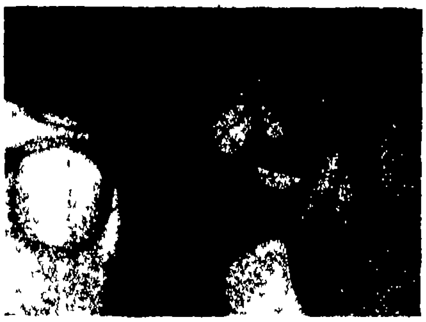
THE HARDNESS, not only of a piece of steel you can feel in your hand and examine with your naked eye, but also of microscopic grains of the steel itself, can be measured accurately by a new device designed at the Research Laboratory of United States Steel Corporation Still more minutely, the micro-hardness tester can gage the hardness of a single steel grain at as many as three points within the breadth of a human hair

By no means an instrument of abstract research alone, this tester is in continuous laboratory use, perfecting studies of the microscopic constituents of steel The results of these studies are coordinated to develop steels of definite hardness and toughness for specific applications in the home and factory, and on railroads, ships, planes, and automobiles

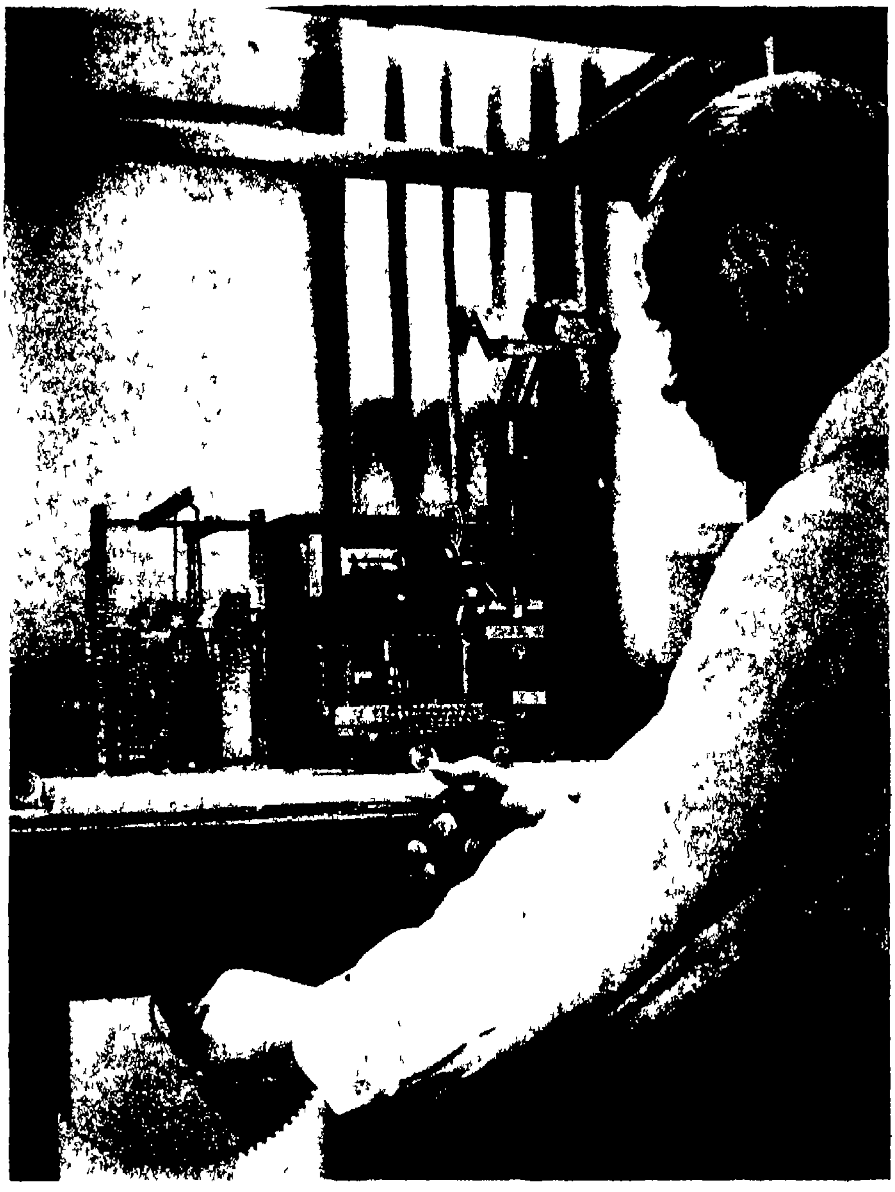
Like the Brinell, Rockwell, Vickers, and other traditional hardness testers, but on a much finer scale, this device operates by indenting the polished surface of a steel sample Its diamond-point penetrator under a load of a very few grams leaves a square mark which can rarely be seen by the naked eye The diagonals of this tiny square indentation are measured in microns, or thousandths of a millimeter, and this reading related to the load placed on the penetrator so that hardness may be computed

Preparation of the sample of steel whose hardness is to be measured requires elaborate care A small sample, which may be mounted in plastics, is ground and finished with polishing paper, care being exercised so the grinding effect does not extend below the surface Then it is polished on wet lead laps Alternately, the sample is polished to a mirror finish with a soft abrasive so finely divided that when shaken in water it will take a half hour to settle, and then lightly etched with acid to bring out the grain boundaries This dual process is continued until no disturbed metal is observed under the microscope

The operator of the micro-hardness tester places the prepared sample under the microscope on a



Pyramidal diamond point of penetrator is cut to an angle of 136 degrees



Illustrations courtesy United States Steel Corporation

After steel grain to be tested has been selected under the microscope (right), specimen on movable bed plate is transferred to penetrator mechanism (left) movable bed-plate and selects the grain or area to be tested When this is determined, the sample is transferred to the penetrator mechanism The penetrator arm, balanced with its adjustable weight suspend on knife edges, slowly bears down its weight to make the indentation

After the indentation has been made, the sample is moved back under the microscope and examined Depending on the hardness of the sample, indentations may range upwards of two microns in depth, which is proportional to the diagonal of the square indentation This too is measured in microns, one micron equalling roughly forty millionths of an inch The device makes possible the measurement of hardness gradients within areas too small to permit satisfactory exploration with any of the usual testers

The micro-hardness tester measures with amazing accuracy the hardness of the hardest steel constituents This is necessary to know the degree of hardness of steel grains themselves, and of the iron and other alloy carbides The mechanism consists of the indenter with a square-base, 136-degree diamond pyramid penetrator, the mechanical stage for holding the specimen, a microscope capable of magnifying the test field 500 to 1500 times, and a control box All parts are assembled on a heavy cast-iron plate supported by steel legs which rest on insulated wooden blocks to minimize effects of vibration present in the building As many as 60 indentations may be made automatically at predetermined time intervals for surveying tiny gradients, which may have an important influence on the behavior of a fabricated product such as a weld

Fatigue tester, shown at left, compresses three years' walking into ten days

ARTIFICIAL LEGS

Tested Under Accelerated Conditions

Making an artificial leg "walk" at the rate of 3,000,000 steps in ten days —the equivalent of three years of normal wear, a fatigue tester will permit faster testing and development of improved artificial limbs for this country's 20,000 veterans and 65,000 war workers who have had amputations

A 300-pound load, over one and a half times that of the average man is shifted continually from heel to toe of the foot of the artificial leg at a rate of four complete cycles a second, which means that the leg actually is "running" as fast as the swiftest athlete Thus the amount of punishment it would take over a period of years is concentrated into a few days or weeks

The machine was designed by William E Dunshee, John F Hopp, and LeRoy Barnes, research associates in mechanical engineering Their work was done under a Northwestern University program of research in artificial limbs for war veterans

The research in which the fatigue tester will be used includes study of the strength and durability of ankle and knee mechanisms, plastics shanks, and plastics cement used to join the parts

In one test, the durability of artificial leg fittings used at Army amputation centers was demonstrated when a leg with the fittings completed 7,190,000 steps without failing, or the equivalent of seven years of normal wear

Knee and ankle mechanisms of light metal alloys may be the parts most susceptible to wear, as evidenced by tests of another model in which the plastics shank remained intact after 4,800,000 steps, but the metal knee cracked after 600,000 steps and metal bearings in the ankle after 410,000 steps An experimental plastics limb now under test has undergone 5,300,000 steps without failure

Strain gages that translate pressure into measurable electric current are attached to various parts of the limb to record the exact pressure and tension in each part Although the over-all load is 200 to 300 pounds, some parts of the knee and ankle mechanisms are so small that pressure concentrated on them is sometimes as high as 9500 pounds per square inch The load on other parts, tests showed, are as low as four pounds per square inch A major problem is to design the limbs so that pressure is more equalized

Preliminary tests indicate that a combination of riveting and bonding (plastics cementing) is the strongest means of connecting joints and that new plastics parts show promise of great strength No plastics part of any limb has failed yet in the fatigue testing machine

LIGHTWEIGHT MOTORS

Made Possible by New Magnetic Alloy

Carrying more magnetism than any other alloy practical for use in motors and generators and tough enough to withstand intense vibration, a 35 percent cobalt, 64 percent iron, 1 percent chromium alloy will make possible compact electric motors and generators an estimated 10 percent smaller and lighter than those of equal power now built for aircraft This is so, because the high magnetic saturation point of the alloy, called Hiperco, will permit the design of motors with less metal for the same power, or more power from the same amount of metal

The combination of 35 percent cobalt with iron gives the highest magnetic saturation point of any known metallic material, and the 1 percent chromium is added to make the alloy workable

The new alloy is the result of 20 years' research by Westinghouse research engineers, with the final difficulty of brittleness being overcome only recently Earlier samples of Hiperco were too brittle to be of great use However, a method of rolling was devised which enables production of a tissue-thin strip of metal tough enough to withstand intense vibration and yet ductile enough to be bent double without breaking

Formerly the metal was "hot-rolled" and allowed to cool slowly but, unlike ordinary iron and steel, cobalt-iron becomes brittle when it cools in this manner It has been found that brittleness can be avoided either by quenching the alloy in cool water, or by continuous rolling while the hot metal cools

Now, with the quenching method in use, Hiperco ingots are rolled into slabs two to three inches thick, reheated to a high temperature, and rolled again to a thickness of one tenth of an inch As the strip emerges from the last set of rolls, it plunges into a trough of cooling water

The sudden cooling makes the metal so strong and workable it can be coiled like wire, whereas formerly it could not be bent at all The cool metal then goes through a "cold rolling" process which can further reduce its thickness to as little as one two-thousandth of an inch For most motor and generator applications, however, a thickness of approximately one two-hundredth of an inch is sufficiently thin

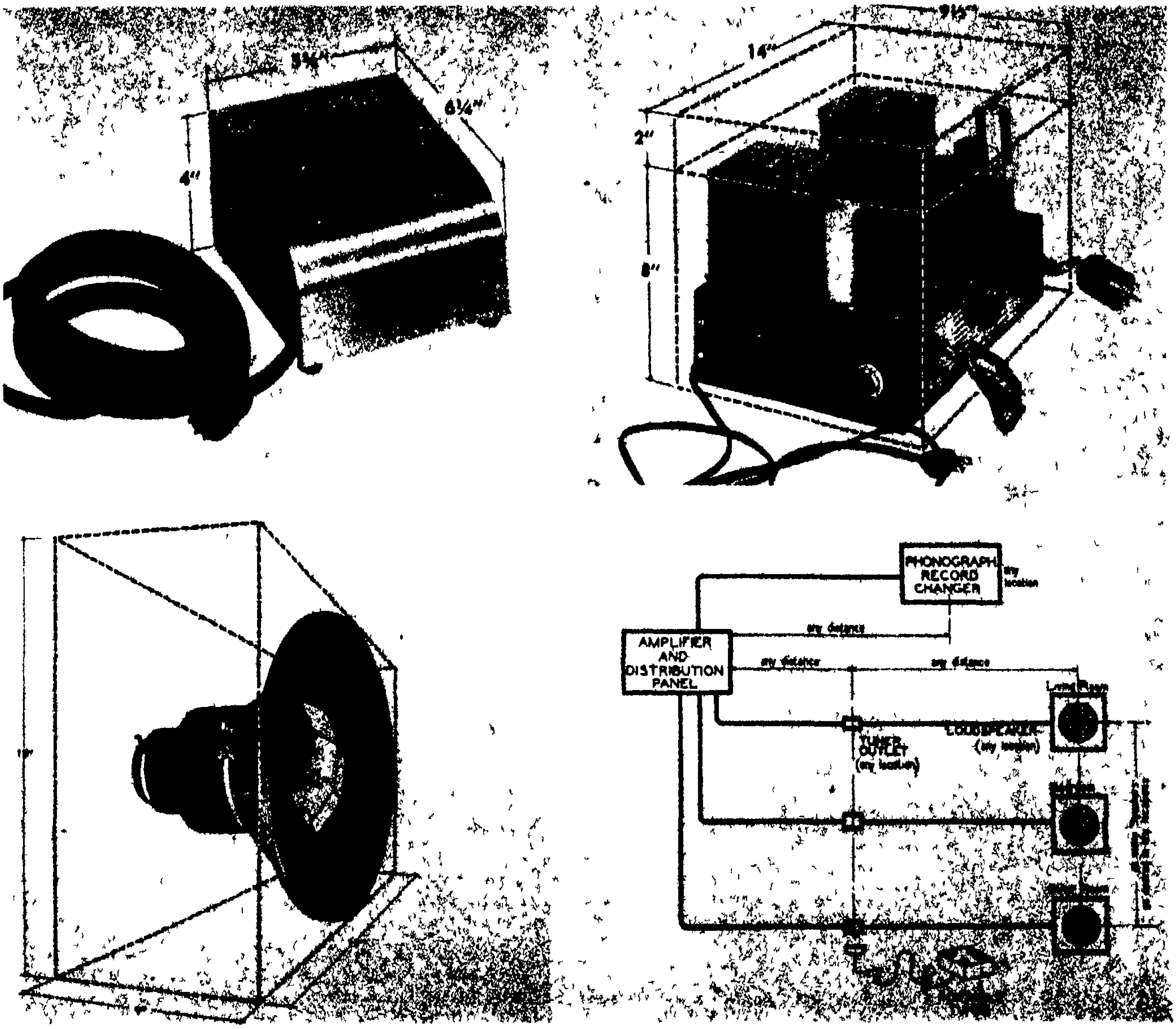
Even though cobalt is a high-cost material, most of which must be imported from Africa, Hiperco will be of value wherever smaller and lighter motors and generators are economically important

Mineralogists now are searching for new supplies of cobalt in the United States, Canada, and China If they should find a sufficient supply, Hiperco might replace other metals in many types of motors and generators Today, however, its cost limits its use to such applications as aircraft where savings in weight and size are important from an operating cost standpoint

HOME SOUND SYSTEM

Serves as Radio and Record Player, Is Built into Walls

Engineered to be a functional part of a home, a built-in radio and sound system consists of four major parts a portable tuner, an amplifier, a record player, and one or more speakers, plus an antenna and the necessary wiring to connect the various units The portable tuner, about the size of a cradle telephone, is the only part of the system which appears in the room All other units are concealed in the walls or other


9¼"
6¼"
4"
14"
2"
8"
PHONOGRAPH RECORD CHANGER
any location
any distance
any distance
any distance
AMPLIFIER AND DISTRIBUTION PANEL
TUNER OUTLET (any location)
LOUDSPEAKER (any location)

Tuning unit of new sound system (upper left) can be used in any room having a speaker and tuner outlet Amplifier unit, with an output of 15 watts (upper right) can be located in any out-of-the-way place The high fidelity speakers (lower left) are concealed in recesses in the wall, and cover the entire range from 30 to 15,000 cycles Block diagram (lower right) shows system's flexibility suitable space The amplifier unit can be placed in a closet, the basement, or the attic By eliminating the costly cabinet, a considerable saving is achieved

Simplification of both the wiring and installation requirements for the Reeves Soundcraft Radio system makes it possible for the builder and a competent electrician to incorporate the various units into any home The speakers and their connections are mounted on a panel for easy installation, while special outlets to receive the plug-in jack of the tuner can be provided, where desired, in rooms that have speakers For each speaker location, an on-off switch is available for listening to a program that is tuned in by the portable station selector in another room. The record player plays through the radio amplifier but is controlled at its location independent of the radio tuner

POWDER METAL BEARINGS

Wear Long Without Additional Lubrication

DESPITE severe usage, Americans may expect a great increase in the useful life of home appliances, farm machines, automobiles, airplanes, and factory machinery as the result of new developments and improvements of self-lubricating bearings which in tests have completed the equivalent of 14 years of continuous operation with no perceptible diminution of oil supply and a minimum of wear on the bearing metal made from powdered metals

Oilite bronze precision bearings made by The Chrysler Corporation, permit use of lower bearing clearances than is possible with solid cast bronze thereby assuring quiet operation and greater bearing life

These bearings can be made to many desired specifications as to physical properties and chemical composition. With proper design, Oilite bearings have carried loads exceeding those under which cast bronze and hardened steel have failed.

Other advantages of the self-lubricating bearings include elimination of oil drippage and the fact that there is now a large supply of the metal powders from which they are made

GASOLINE FROM GAS

Seen Economically Possible, With Fluid Cat-Cracking

DUE to the utilization of certain principles developed in the fluid catalytic-cracking process, conversion of natural gas into gasoline is now economically competitive with production of gasoline from petroleum, it was reported at a recent American Gas Association meeting Also, it was declared that production of gasoline from coal is practical but not now, in general, competitive with production from crude oil The development of coal conversion processes, however, is continuing

ELECTRONIC ANNEALING

Increases Speeds and Lowers Costs in Milk-Can Fabrication

ADOPTION of electronic heating in the manufacture of milk cans at the Buhl Manufacturing Company, has resulted in increased production of cans, lower manufacturing costs, and a more durable finished product

Prior to the installation of two five-kilowatt General Electric electronic heaters, the entire breast of a milk can had to be annealed in a gas-fired furnace, although only the neck of the can needed to be heated Then the can had to be pickled to remove the scale before finishing

Courtesy General Electric Company
In 12 seconds the milk can's neck is brought to a red hot temperature

With the new method, it is possible to anneal as little as an inch of the neck of the can The piece can be brought up to a red temperature in 12 seconds Since the heater has a two-position transfer switch, one piece can be heated in one heating position while the other position is being unloaded and reloaded At the end of the heating cycle, the power is transferred from one heating position to the other by the throw-over switch

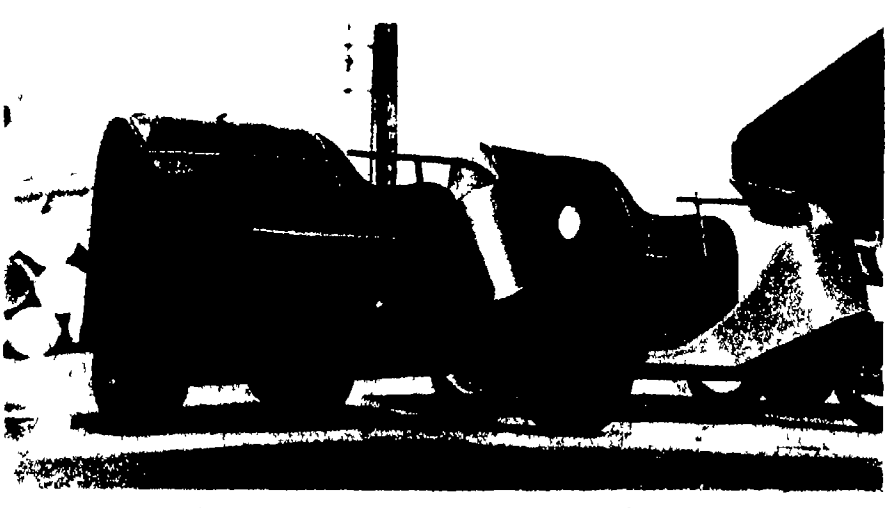
The electronic heater is located directly in the production line As a result one operator can anneal more cans with the present system than two men using the former method which necessitated removing the cans from the production line, moving them to the annealing furnace pickling them, and returning them to the line

RUNABOUT BODY

Easily Formed of Durable Laminate

OF SPECIAL interest to automotive and aircraft manufacturers and other industries using semi-structural parts, is a new application for plastics—the body of an electric runabout, called the Autoette The body section for this vehicle, with an area of approximately 20 square feet, is laminated Fiberglas which has been impregnated with American Cyanamid's Laminac resin The one-piece structure is molded into complicated, curved forms

The Autoette body, manufactured by the Triangle Boat Company, is adaptable to use in industrial plants as well as for local, personal traveling The original design called for an all steel frame, but the manufacturers of the Autoette have


The wear resistant body is formed in a single piece

recently switched to laminated plastics The fact that a large section can be molded over an inexpensive form, plus the weather resistance and general durability of this type of construction, were largely responsible for the change

Actual technique of manufacture of the laminated plastics body consists of laying up Laminac resin impregnated Fiberglas over a male mandrel which has previously been covered with cellophane, curing, and then repeating the process with additional layers The finished body is painted and is said by the manufacturer to be durable and resistant to weathering and denting

MINERAL DEPOSITS

Located By Analysis of Clay

A technique for discovering mineral deposits which has given early evidence of being able to add substantially to the nation's dwindling mineral resources has been reported by Paul F Kerr, professor of mineralogy at Columbia University and president of the Mineralogical Society of America

The technique is known as "alteration study" and involves the careful study of the clays found in the vicinity of mineral deposits Particular attention, according to Professor Kerr, is paid to the processes of nature that have destroyed original rocks and left in their place clay and various other types of alteration minerals These alteration minerals constitute the clue that leads to the mineral deposit

The alteration study method has been in use by Professor Kerr and others in the southwestern states for the past five years As a result of work with Columbia geology students in co-operation with various mining firms, considerable success has resulted from the method

When the alteration study technique is developed to its expected possibilities, it will give the mining industry a valuable weapon in the fight to increase the rate of mineral discovery

COLOR TELEVISION

Electronically Produced By Splitting Light Beams

Without rotating disks or other moving parts, a new color-slide television camera produces full-color television pictures by all electronic means. This camera, recently demonstrated by its developers, the Radio Corporation of America, produces signals from 35-mm Kodachrome slides Transmission of the picture on the slide is achieved in natural colors when a light beam from a kinescope is focused through the slide and separated into component colors by a system of mirrors and photoelectric cells

At the camera, light from cathode ray tube passes through color slide The resulting image is separated into its component colors, and each color is then reflected to a photo-electric tube where it is changed to electrical signals

Each of the three resulting images—red, blue, and green—is of the same number of transmission lines, that is, 525, also, the horizontal scanning rate and the picture repetition rate of 30 pictures per second is the same as in present commercial television broadcasting

The receiving set is equipped with three three-inch kinescopes, which separately receive the signals representing red, blue, and green This trio of kinescopes is called a Trinoscope From it the three color images are optically projected into a composite picture which appears on a 15 by 20-inch screen in natural color, free from flicker, color fringes, or break-up of color

By this new advance in television, simultaneous color transmission, instead of sequential transmission, color by color, is achieved

HIGHWAY STANDARDS

Probably Will Change Little During the Coming Year

Despite accelerated repair and new construction activities in every state, the nation's 300,000 miles of paved highway will incorporate few engineering changes this year, in the opinion of T R Johnson, general manager of the American-Marietta Company's Keystone Asphalt division

Releasing a summary of highway pavement specifications obtained in co-operation with state highway officials, Mr Johnson revealed that only ten states contemplate any changes in highway standards during 1947

Amplifying information secured in the nation-wide survey, he declared "In the move toward national engineering standards for State and Federal sponsored highways, only the expansion joint has made appreciable progress, with 38 states accepting the principle that expansion joints are essential" Expansion joint spacing ranges from 60 to 600 feet, with contiguous New Mexico and Arizona representing the extremes The average spacing for highway expansion joints is approximately 200 feet

At receiver, images from the three kinescopes are cast onto mirror and reflected to screen where they superimpose, reproducing scene in color

Preformed mastic board and poured rubber asphalt contraction joints at spacings of 15 to 20 feet are specified in 90 percent of the states reporting definite standards Asphalt and fiber are the preferred expansion joint materials, with cork, steel, wood, sponge rubber, and cottonseed hulls being used in a few regions

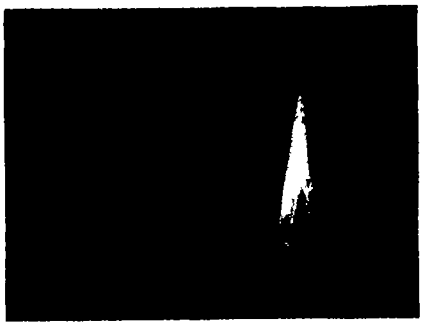
Curing processes also are approaching national standardization, with 33 states approving the membrane cure techniques

New Products and Processes

SELF-SOLDERING TAPE

Supplies Own Heat, Needs Neither Torch Nor Iron

Soldering splices in electrical wiring, and similar small soldering jobs, can be accomplished without the use of either an iron or torch with a recently developed self-soldering tape. Made with a strip of regular solder on one side and a strip of flexible, flammable plastics on the other, the tape assures a perfect soldering job, greatly speeding and simplifying the usual process. To use, a piece of the tape is pressed firmly around the entire length of a flux-coated splice. Then the plastics strip is ignited with a match or cigarette lighter. The intense heat from the burning plastics not only melts the solder, but also thoroughly heats the work, allowing the solder to flow freely into the joint. When the flame burns out, the soldering is completed. Even in the most inexperienced hands, there is absolutely no danger of a cold-solder joint. The tape, called Neat-N-Nifty Self-Soldering Tape, is offered by the W. B. Franklin Company in a kit containing also a supply of flux and full instructions.


Tape is ignited with match or lighter

SHRINKPROOF RAYONS

Withstand Heat and Are Easily Handled

Assuring no more than 2 percent shrinkage or stretching, a newly developed process permanently stabilizes viscose rayons. Commercial finishers licensed to use the process have already begun turning out stabilized rayons and, bearing the trade mark Sanforset, the treated fabrics are expected to be available in the fall.

The process, called BR-I Stabilizing Process by its developers, Cluett, Peabody and Company, eliminates many of rayon's most serious disadvantages. Permitting the fabric to be washed without special handling, the expense and bother of dry-cleaning are avoided. Ironing the treated rayons is also greatly simplified.

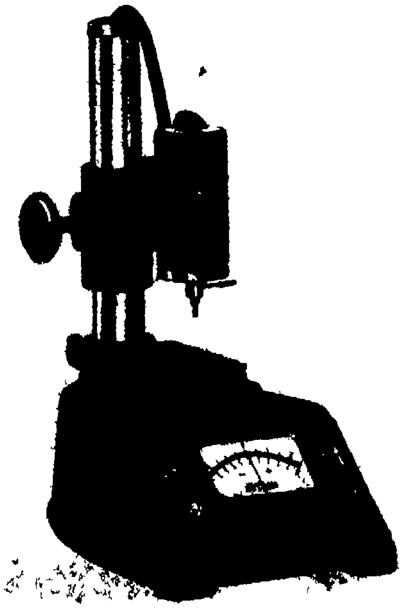
The results achieved by the BR-I process of stabilization are permanent, it is claimed, because there is nothing introduced into the fabric to wash out. The "hand" of the fabric is not changed and any desired finish may be obtained. It also is easier to handle on the cutting table.

Multiple laundering tests indicate that the wash durability of the stabilized fabrics was actually greater than that of untreated fabrics. There is no need to "baby" the treated garment in washing and it will retain its original fit whether washed at 100 or 212 degrees, Fahrenheit.

MAGNETIC COMPARATOR

Has Four Ranges, Uses No Vacuum Tubes

A comparator gage, which is of the electromagnetic type, having no vacuum tubes or other components of limited life, has four ranges of magnification (selected by means of range switches) so that a single gage is suitable for a wide range of gaging applications from checking gage blocks to production inspection of machined parts. Three models of the gage, a product of the Merton Instrument Company, are available, calibrated in either English or metric units. Model 10 has a gaging range from 0.000001 to 0.0004 inch. Model 20 has a range from 0.000010 to 0.005 inch. Model 30 has a range from 0.00005 to 0.020 inch. The spindle pressure is adjustable and calibrated from 4 ounces to 2½ pounds and the head can be rotated at any angle about the column or in the vertical plane. The head can be removed for special setups if desired. The gage has only two moving parts: the spindle, which is supported in flexure, and the pointer, which is mounted on jewel pivots. This assures millions of gaging operations and years of service without maintenance.


Fits wide range of gaging applications

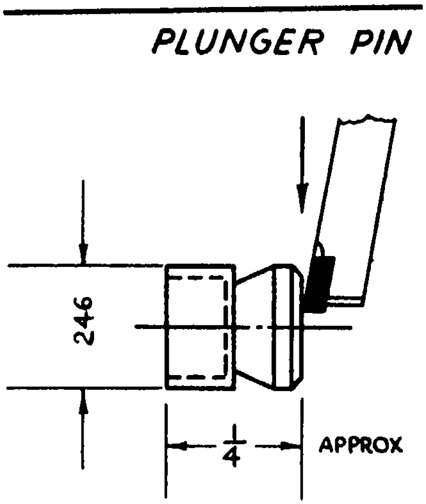
A complete line of accessories is available such as large anvils, stops, flat tips, over-hang supports, V-anvils, and so forth, for accurate measurements of parts of all shapes and materials.

FINISH GRINDING

Operation Eliminated by Carbide Tool

Elimination of the need for a final grinding operation together with increased production speed and a tenfold increase in life between grinds of tools, has been achieved through the use of standard Carboloy turning tools in place of high-speed steel tools on a facing operation in a large manufacturing plant.

The operation consisted of facing plunger pins of S.A.E. 1035 bar stock. The manufacturer reports that, with high-speed steel tools, some 1000 pieces were faced between grinds. Moreover the end of each plunger pin had to be ground in order to obtain a satisfactory finish.



Sketch of facing tool in use

When standard Carboloy T-41 tools were installed in an effort to speed production, the tool life between resharpenings jumped to 10,000 pieces. Furthermore, the new tools produced a degree of finish on the pins which made the final grinding operation unnecessary. The tools were tipped with Carboloy Grade 78, a type of carbide possessing high wear resistance The only special tool grinding required to fit the standard tools to this job was to increase the front relief angle from 7 degrees to between 25 and 30 degrees in order to clear the work

Facing was perfomed on a Brown and Sharpe Automatic Number 00 Feed was 0018 inch Depth of cut varied from 002 to 005 inch The machine speed was raised to 3300 revolutions per minute—which was maximum for the machine—giving a cutting speed of approximately 200 surface feet per minute

INSECTICIDE SPRAYER

Electrically Operated, Has No Moving Parts

Representing a new principle of insect control, an Aerosol gun's operation is unusual in that it has no moving parts and does not employ steam The gun automatically converts Aerosol concentrate to gas by means of a thermostatically controlled heating process Electrically operated (115 volt A C -D C), it weighs but 6 pounds, is 12 inches long and 9 inches high The case is of molded plastics and all parts are entirely self-contained To operate, the filler cap is removed from the back plate and a charge of concentrate poured in A few minutes of heat are required to change the liquid to a gas after which the Commando Aerosol Gun, a product of Mayfair Industries, is ready for several hours of operation Sufficient pump pressure results to discharge the dry gas eight to ten feet with a fog that is not readily dissipated

The dry gas is deadly to cockroaches mosquitoes, flies, bedbugs, spiders, moths, fleas, ants, silverfish weevils, and many other insects Reported as non-toxic by the American Research and Testing Laboratories, it leaves no oily film or unpleasant odor and will not contaminate food products

SPIRIT LEVEL

Of Acrylic Plastics, Indicates Six Angles

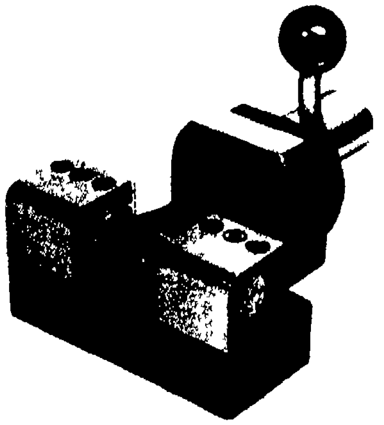
Pocket-sized, a new spirit level, molded from transparent Plexiglas, is light-weight, sturdy, and shock resistant A result of the combined engineering efforts of Lawco Plastic Products Company and Sobenite, Inc, the spirit level indicates six different angles 22½ 30, 45, 60, 90, and 180 degrees To simplify the identification of these angles, the degree of each angle is molded into the plastics, and different colored fluids are employed for each indicator The close tolerances used in the molding process eliminate the need for adhesives to hold the dime-sized indicators in place All parts of the level are molded simultaneously in a seven-cavity mold

Each angle is clearly marked

KNURLING TOOL

Produces Various Patterns Without Changing Knurls

Adaptable to any engine or turret lathe, a cam-action retractable knurling tool will rapidly knurl long, thin work and will clear threads, pilots and other sections of the same diameter as the portion to be knurled Made by the Universal Vise and Tool Company, it can be instantly adjusted to any diameter up to two inches the cam-action retracting mechanism is self-locking to free the operator's hands while the tool is feeding Formation of different knurl-patterns without changing the knurls is possible and the use of standard knurls permits easy replacement

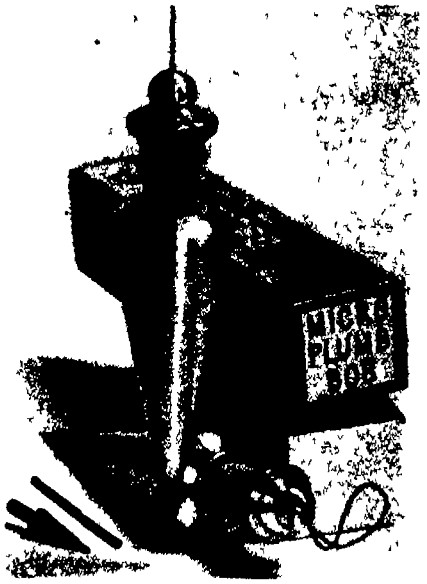


Takes work up to two inch diameter

PRECISION PLUMB BOB

With Minute Adjustment Promotes Speed and Accuracy

A quick-acting, precise plumb bob for use by carpenters, mechanics, construction men, surveyors, and so on, has a rotatable reel at the neck Cord is reeled off to the approximate length wanted, and then slipped into a hook on top of the neck, which holds bob exactly centered anywhere on the cord The bob can then be minutely adjusted up and down simply by rotating the spool When not in use, the spool and hook hold the cord neatly and securely in place, even with the bob carried loose in a tool box Rugged and simple in construction, there is nothing to get out of order, even when working in wet mines



Forged brass, steel tipped

Carefully engineered and thoroughly field-tested, this Micro Plumb Bob is constructed of dense, forged brass, with a steel point, heat treated for toughness and hardness The popular 10, 12, 14, and 16 ounce sizes are available, and each bob is supplied with tool-steel pin, cord, and an additional precision point

VULCANIZED STARCHES

Resist Swelling Action Of Heat and Chemicals

Having countless potential applications in industrial fields, "vulcanized" starches are resistant to the swelling action of heat and chemicals and are available with various degrees of non-swelling and non-gelatinizing characteristics Wide-spread use of the partially treated starches, produced by National Starch Products, Inc, is suggested by a number of possible applications such as in printing thickeners in textile operations, certain creams in cosmetic fields, electrolyte carriers in dry-cell batteries, or as ingredients for canned soups In the printing and paper trades, these materials, known as Vulca starches, are adaptable as dusting powders, beater sizings, or as additives to tub sizings

The completely vulcanized starch known as Vulca-100 answers industrial requirements for an inert, non-toxic organic filler or ingredient It can be cooked in boiling water or a 5 percent alkaline solution without increasing its average granule size more than five microns Approximately neutral in water suspension, the starch settles after cooking, because the granules are not appreciably swollen or ruptured

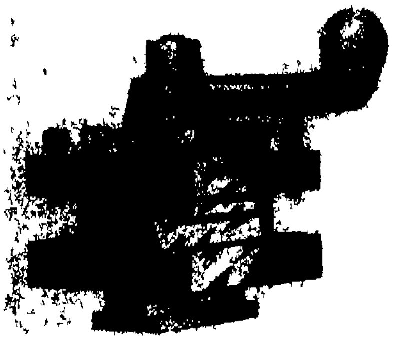
The product is non-toxic and is not rapidly hydrolized by acids or enzymes Steam sterilization makes no essential change in any of the properties of Vulca-100

POST TURRET

Eliminates Resetting by Holding Four Tools Simultaneously

COSTLY set-up time and down time in general tool room lathe work is virtually eliminated through use of a new tool post turret Bolted firmly in place on the lathe, this tool post turret, produced by the Crozier Machine Tool Company, holds any four tools simultaneously, thereby doing away with resetting and recentering of tools in 90 percent of work operations

Indexing is accomplished simply by "opening" the handle and revolving the turret manually The pre-location is determined automatically by a powerful detent mechanism without the operator having to feel for the correct position



No need to feel for correct position

When the turret has been revolved to the desired tool, the handle is "closed" No auxiliary operations are necessary —no pins to pull or levers to throw Close indexing is maintained by hardened pins closely fitted into holes in the hardened body

WING NUTS

Made Self-Locking With Nylon Inserts

FEATURING an elastic nylon locking collar, a self-locking wing nut has been developed to answer design requirements calling for the convenience of a wing nut plus the ability to lock in position anywhere on a bolt or stud Potential applications of the self-locking wing nut exist on household appliances, children's toys, garden equipment, folding chairs, furniture, office equipment, automobiles and trucks, industrial equipment and special machinery of all kinds

The wing nuts, produced by the Elastic Stop Nut Corporation of America, are available in four diameters with both fine and coarse threads Machine screw sizes, in fine threads, are 8/32, 10/32, and 12/28, with the fractional size of 1/4-28 Coarse thread sizes are 8/32, 10/24, and 12/24, in addition to 1/4-20

The locking torque characteristics of these wing nuts have been tested under severe conditions and they have shown retention of locking effectiveness through 200 applications and removals The wing nuts are made of die-cast zinc, with all nuts in regular production supplied in plain finish Nickel plating can be furnished on special order

OXIDIZING COMPOUND

Gives Silverware Antique Appearance

PRODUCING a black to gray oxidized finish on sterling silver, silver-plated flat ware, or hollow ware, a compound known as Platin-Nig, product of the Hanson-Van Winkle-Munning Company, gives that antique look to the treated pieces No electric current is required for the process The work is simply dipped into the easily prepared solution and then high-lighted for the desired light and shadow relief

PORTABLE POWER BURNER

Can Produce 15-Foot Flame of 2000 Degrees

ANSWERING the need for a large, portable, self-contained piece of equipment to provide a high-temperature flame for industrial work is a power-driven burner which is self-starting and has no chains, belts, or gears

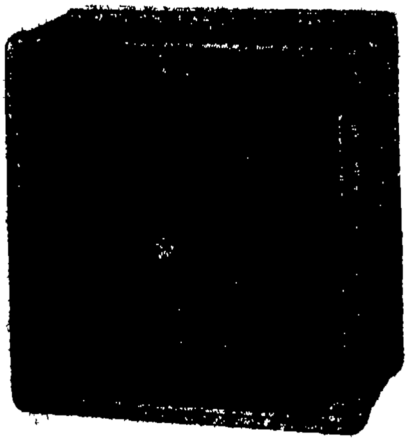
The burners used on this unit make possible working in a vertical as well as a horizontal position without affecting the volume or density of the flame By regulating the air and fuel valves, any type and length of flame can be produced from six inches up to 15 feet, with temperatures up to 2000 degrees, Fahrenheit The burner, produced by Aeroil Products Company and Schramm, Inc, operates on kerosine or any oil up to Number 3 fuel oil

Although this model was originally designed as a weed burner for agriculturalists, high-way engineers, and railroads, it has many uses in industry, for such work as straightening, bending, shrinking, and expanding, skin drying foundry molds, heating plates, ribs, and girders, and for general repair work

SIGNALING TIMER

Opens or Closes Control Circuits

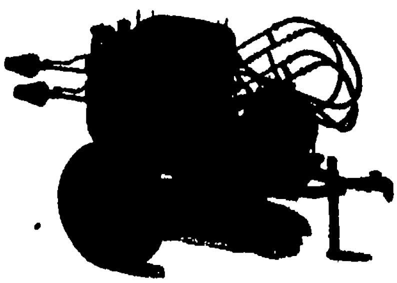
COMMANDING visual and audible attention the instant a pre-selected time interval is completed, a signaling timer provides for automatic closing or opening of a circuit at the end of elapsed time, and operates additional buzzers, bells, or lights at remote locations



A buzzer sounds and pilot light goes out when time interval is completed

When the pointer on the timer is manually set to the required interval shown on the dial, a circuit is closed which operates a pilot light indicating that the time interval has started The moving pointer revolves counter-clockwise toward zero, at any second during the interval the exact time elapsed is shown on the dial When the interval is completed, an audible alarm sounds and the pilot light goes out. The buzzer continues to sound until the toggle switch on the timer is snapped to "off" position or the timing interval is again started by moving the pointer knob

Two sockets are provided on the



Above Close-up of the power burner with two torches in brackets on the side Left The burner in use, operating three four-gallon-per-hour torches. Note length of flames and large working radius possible

Editorial purpose of Scientific American is to provide its readers with thought-provoking feature articles and shorter items on all phases of industrial technology In every case the material is drawn directly from industry itself The Editor will be glad to refer interested readers to original sources and, when available, to additional literature, giving further details of a more specialized nature

side of the case, one for normally open, and the other for normally closed circuit control They provide for connection of additional lights or alarms Rapid resetting of the pointer knob, when the same time interval is to be repeated indefinitely, is afforded by a quickly adjustable back stop

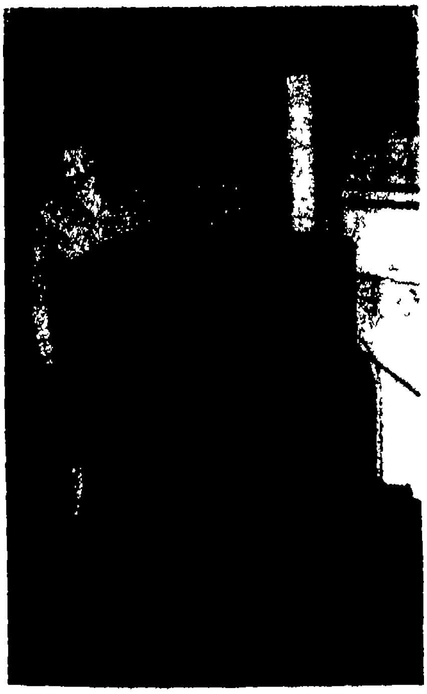
This timer, a product of the Industrial Timer Corporation, is enclosed in a metallic grey case, 5 by 5 by 3½ inches deep and is readily attachable to any wall or panel or standard switch box It operates on alternating current, 115 or 230 volts, 25, 50, or 60 cycles, voltage and frequency to be specified The motor is slow speed, self-starting synchronous type Pure silver contacts are used throughout. Connection to the line is made with line cord Voltage, frequency, and switch rating are plainly indicated on the name plate

SMOKELESS HEATERS

Prove Efficient In Field Tests

COMMERCIAL models of a smokeless heater have undergone practical field tests in four major cities—Chicago, Cincinnati, Indianapolis, and Pittsburgh

Early reports indicate that these



These heaters require less manual attention than do conventional models

CHANGING TIMES SHOULD BE SUCCESSFUL TIMES FOR EXECUTIVES!

Today, war worries have been succeeded by an atomic turmoil Far-reaching changes have always followed wars—and the man who has kept pace always comes out on top

Come what may, one need is never completely filled—the need for competent executives to direct business and industry In tumultuous times like those of today, this demand multiplies Right now, the outlook for ambitious men is brighter than ever before—if they have the training to take advantage of opportunities

The training needed is not narrowly specialized, but goes broad and deep, probing the basic principles that underly *all* business It provides the knowledge that enables men to direct the activities of others not in one department or one kind of business, but in *any* business It supplies the "know how" that enables top executives to manage *any* business

How to get such executive training

Training of this kind is provided by the Modern Business Course and Service of the Alexander Hamilton Institute The Course covers the four major functions of business—Production, Marketing, Finance and Accounting It turns out not accountants, or salesmen or production men, but *executives!*

Takes months instead of years

This knowledge takes years to acquire by ordinary methods Through Institute training, the process is concentrated and thus finished in a matter of months. It does not interfere with a man's present position, being taken at home, during spare hours More than 430,000 men have subscribed, many call it "a turning point in their lives"

Many prominent contributors

One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors Among them are such men as Thomas J Watson, President, International Business Machines Corp, Frederick W Pickard, Vice President and Director, E I du Pont de Nemours & Co., Clifton Slusser, Vice President, Goodyear Tire & Rubber Co, and Herman Steinkraus, President, Bridgeport Brass Company

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Does anybody make them?

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High vacuum chambers are used in the production of our mirrors

EVAPORATED METAL
FILMS CORPORATION
ITHACA, NEW YORK

heaters are giving smokeless performance with high-volatile coals, and trouble-free operation Also they require less manual attention than conventional heaters

In its present size, the Smokeless Heater, developed by the Bituminous Coal Research, Inc, is designed to operate for a 12-hour period without attention, yielding an average of 35,000 BTU's an hour For shorter periods it will burn up to six pounds of coal per hour with corresponding increase in heat output

Laboratory burning tests in the latest model, using high-volatile coals, are giving excellent performance with smokeless operation, it is reported The self-feeding principle operates well, and "puffing," a troublesome drawback with some magazine-feed designs, has been eliminated

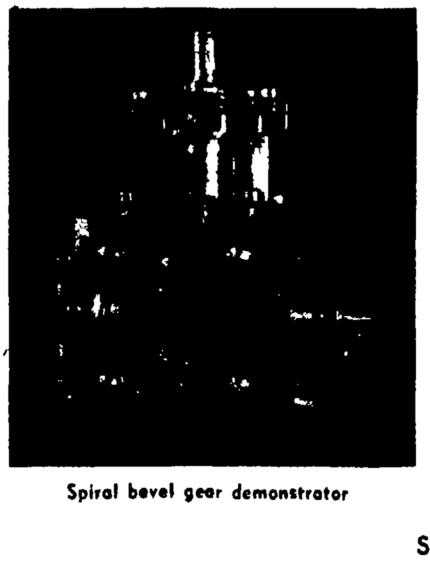
Having emerged from the research stage with design principles well established, the BCR Smokeless Heater is expected to be produced in quantity prior to the 1947-48 heating season It is believed that these heaters will offer a considerable selection in price range, capacity, and exterior finish Some combine the radiant and circulating principles of heat transfer while others are strictly circulators They are of the magazine type with easily operated and precise controls, and employ fundamental principles of smokeless combustion These combustion principles can likewise be applied to warm-air furnaces, ranges, and boilers

Development of the space heater was given priority over other type of heating equipment because of the vast number of them required in cities enacting smoke control legislation In Pittsburgh alone, it is estimated that 53,000 units will be required to replace heaters that cannot burn high-volatile coal smokelessly

PLASTICS GEAR HOUSING

Permits Close Observation Of Moving Parts

A DEMONSTRATION model of a spiral bevel gear has been created by enclosing all working parts of the gear in acrylic plastics so that the operation of the various parts may be observed to determine how the gear functions In the actual assembly, constructed by M L Bayard and Company, Inc, all moving parts are made of steel For any one predetermined gear ratio, the mounting flange and distance from the flange to the center of the assembly remains constant

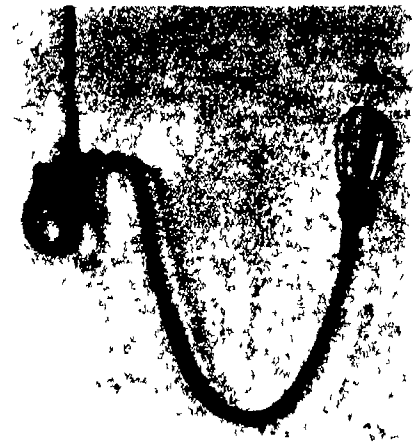

Spiral bevel gear demonstrator

The gear is enclosed in its transparent housing by bolting thick machined pieces of Plexiglas together to form the box-like case Space between sections prevents interference with the mechanism, and the gear is operated by revolving either one of two exterior rods connected to the mechanism

KINK-FREE CORD

On Trouble Lamp Recoils Automatically

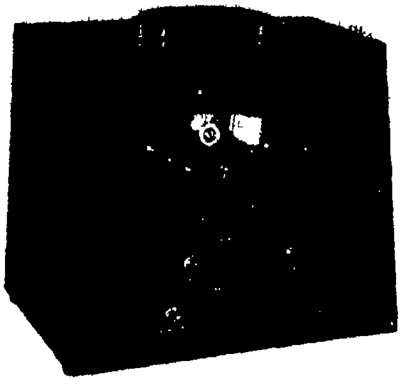
EQUIPPED with a 25-foot self-recoiling cord, a new trouble lamp is completely free from the kinks and snarls that plague conventional models With its cord jacketed in neoprene and therefore impervious to steam, water, oil, grease, and most acids, the lamp, known as Recoilo-Lite, is moveable to any outlet and adjustable to any length by means of a safety clamp which also guards against accidental pulling from the socket The cord's retractibility insures its long life by preventing the cord from dragging on garage or service department floors or from becoming caught in industrial plant motors or machinery The cord extends from a 43-inch retracted length to 25 feet It is also available in 35-foot lengths Recoilo-Lite, produced by the Kellogg Switchboard and Supply Company, will be sold through mill supply distributors and through automotive jobbers


Impervious to water, oil, most acids

COMMERCIAL WIRE RECORDER

Can Be Used With Existing Amplifying Equipment

BEING turned out on a mass-production basis, a new magnetic wire recorder has been developed jointly by The WiRecording Corporation and the Armour Research Foundation This recorder is designed for general com-



Sound on wire unit

mercial use by recording studios, radio stations, schools, theaters, industrial plants, and other companies operating public address and recording systems. Known as the Model B sound-on-wire recorder, it is interchangeable with most sound-on-disk and sound-on-film recording equipment. It can be used with any suitable amplifying system already in operation, and does not duplicate any of the parts of such a system. It makes available to an established sound system the advantages of high quality, low-cost wire recording, by the simple interchange of the recording unit. Installation is easily made with cables with which the recorder is equipped, and operation requires no technical knowledge.

The recorder utilizes a fine, stainless steel wire, a mile and a half of which winds on a spool 2½ inches in diameter and ¾ inch thick, which will record continuously for one hour.

Wire recordings are permanent. A spool may be played hundreds of times or stored indefinitely. However, if one wishes to use the wire again, as for office dictation, the recording on the wire is automatically erased as the wire passes through the machine for new recording. This feature reduces the cost of using the machine to an absolute minimum wherever re-use is a factor. Recordings may be edited by cutting out the unwanted wire with household scissors and tying the ends with a square knot. The knot will pass through the machine without perceptible noise.

Mechanical features of the Model B Wire Recorder include a capstan drive which keeps wire speed constant thus preventing flutter and changes in pitch, magnetic clutches which keep wire tension constant during recording, a cam-operated recording head which winds the wire in even layers on the take-up spool, and safety switches which stop the motor when a spool is almost entirely unwound, thereby eliminating re-threading.

BETTER SYNTHETIC RUBBER

Obtained by Addition of Cross-Linking Agent

IMPROVING the appearance and production efficiency of many rubber products, a "super-processing" synthetic rubber makes possible rubber boots and shoes, bathing caps, and other articles with a bright, shiny appearance produced in any color. It also improves the finish of tire sidewalls by reducing molding blemishes.

This new super-processing member of the rubber family is closely related to the general-purpose synthetic rubber, GR-S. The product obtains its unusual properties from the addition of a "dash"—about 0.5 percent—of a special chemical known as a cross-linking agent. After initial trials of the new product, fabricating plants announced that it is remarkably easy to handle, in some applications it is easier to process than the natural product. For example, tire makers report that less tearing and smoother and better molding are encountered in forming tire sidewalls with the special rubber, developed by the United States Rubber Company.

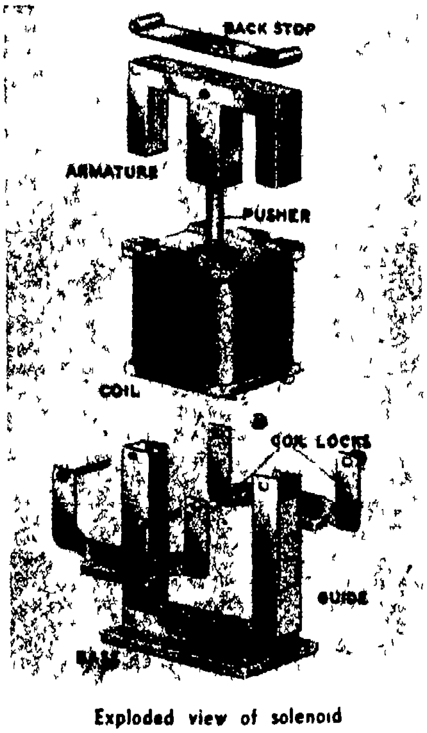
Producers of rubber shoes, boots, bathing caps, and hot water bottles said they favor it for two reasons. It gives better retention of embossed design, resulting in a smoother finish. Also, pieces of rubber sheet cut from patterns shrink much less during fabrication, causing fewer rejects. When using regular GR-S in making footwear, pieces have to be cut a size larger than desired because they would shrink before being built into the shoe.

The super processing synthetic will be made in two types, regular and non-staining. The latter can be used in white or light colored articles since it contains a non-staining anti-oxidant or preservative.

SIMPLIFIED SOLENOID

Has Built-In Pusher To Broaden Application

OF GREATLY simplified construction is a solenoid which consists of only five component parts: base, armature, coil,



Exploded view of solenoid

The new plastics, light metals, and alloys which were developed during the war are rapidly finding their way into more and more peacetime products and uses. Never before have machine tools been called upon to perform so great a variety of exacting operations on so many materials of widely different characteristics. Modern, versatile machine tools are needed for the accurate machining of these materials.

Famed for accuracy and versatility modern South Bend Precision Lathes can play an important part in your shop modernizing program. A nearby South Bend Lathe distributor will tell you how —and why! Write for his name today!

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WAR BARGAINS in LENSES & PRISMS

ASSEMBLE YOUR OWN BINOCULARS

Complete Optics! Complete Metal Parts!

Save More Than ½ Regular Cost

ARMY'S 7 x 50 BINOCULARS Here's an unusual opportunity to secure a fine set of Binoculars at a substantial saving of money Offered here are complete sets of Optics and Metal Parts for the Army's M-16 7 x 50 Binoculars (M-16 is not the waterproof model) These components are new and all ready for assembly We supply full instructions Limit 1 set of Metal Parts and 1 set of Optics to a customer

METAL PARTS—Set includes all Metal Parts—completely finished—for assembly of 7 x 50 Binoculars No machining required Bodies have been factory hinged and covered A sturdy Binocular Carrying Case is included with each set of Metal Parts
Stock #824 S 7 x 50 Metal Parts $35 00 Postpaid

OPTICS—Set includes all Lenses and Prisms you need for assembling 7 x 50 Binoculars These Optics are in excellent condition — perfect or near perfect — and have new low reflection coating
Stock #5102-S 7 x 50 Optics $25 00 Postpaid

NOTICE! If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20% Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled

ARMY'S 6 x 30 BINOCULARS

COMPLETE OPTICS & METAL PARTS — Model M-13A1 Waterproof Model 6 x 30 Binoculars Everything you need — ready for assembly When finished will look like a regular factory job costing $102 to $120 The Optics are new in perfect or near perfect condition Have new low reflection coating Metal Parts are new and perfect all completely finished No machining required Bodies factory hinged and covered Complete assembly instructions included
Stock #830-S $40 00 Postpaid
plus $8 00 tax — Total — $48 00

METAL PARTS ONLY — Model M 13A1 6 x 30 Binoculars No Optics Same Metal Parts as described for Stock #830-S
Stock #832 S 6 x 30 Metal Parts $25 00 Postpaid

OPTICS FOR 6 X 30 BINOCULARS (No Metal Parts) Slight Seconds Cemented and coated
Stock #5124 S $12 75 Postpaid

If you buy both the Binocular Optics and the Binocular Metal Parts your purchase becomes subject to 20% Federal Excise Tax Be sure to add amount covering tax to your remittance or your order cannot be filled

Optics and Metal Parts are Available for Monoculars (½ a Binocular) For Complete Details Write for Bulletin #14 S

AIR FORCES GUN SIGHT—With Polarizing Variable Density Attachment (Polarizing attachment alone is worth many times the price of entire unit)
Stock #908-S $5 00 Postpaid
Same Unit Without Polarizing Attachment
Stock #916-S $2 50 Postpaid

SCHMIDT OPTICAL SYSTEM Black plastic body size 3-15/16" by 5½" F L 2 4" with amazing speed of F O 9 Used in Navy's Infra-Red Sniperscope and Signalling Units Govt cost $134 Limit—1 to a customer
Stock #720-S $6 00 Postpaid

MOUNTED PROJECTING LENS SYSTEM F L 91 44 mm (Just right for 35 mm Projectors) Speed of F 1 9 *Outside dia of mount at one end 60 mm* Length of mount 64 mm
Stock #4033 S $3 00 Postpaid

MOUNT FOR ABOVE PROJECTING LENS SYSTEM
Stock #715 S $1 50 Postpaid

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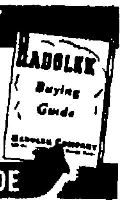

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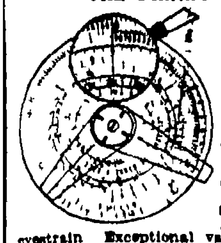

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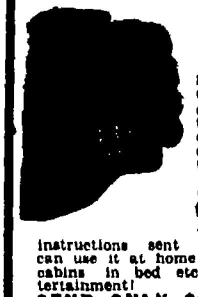

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TWO MONTHS ago in this space we described Broadhead's mirror grinding technique, last month the question of thin mirrors was discussed, and now the two are conjoined Broadhead making a pair of thin mirrors

Recently, Dr John Strong, author of the widely used book "Procedures in Experimental Physics" and now professor of experimental physics at the Johns Hopkins University, asked this department whether some of the advanced amateur telescope makers could make, for non-astronomical research in the infra-red, a matched pair of 36" spherical mirrors of 1¼" plate glass (thickness-to-diameter ratio, 1 27), of focal length between 99' and 101' (f/33) and in focal length not more than 6" different from each other, with a circle of confusion (pinhole image) at center of curvature not greater than ⅛" diameter in single reflections These mirrors were to be centrally perforated with 6" holes, mounted in metal cells, and delivered within 90 days Thereafter, at the Johns Hopkins University, they were to be set in an air-tight tube 100' long, which tube could be partly exhausted and cooled to simulate all atmospheric conditions as high as and including the stratosphere The set-up is like that shown diagrammatically in Figure 1 (Without the small mirrors to offset it the light beam would inescapably return to the pinhole, no matter how the mirrors were tilted)

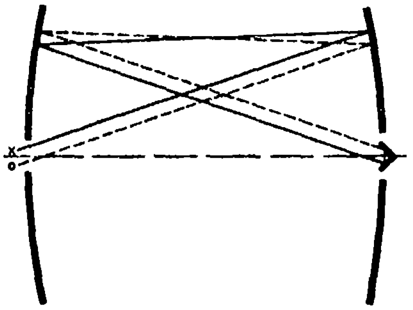

Figure 1 Set up (diagrammatic)

This job went to Dave Broadhead, Wellsville, N Y, whose precision optical background was as follows Prewar, had made a small objective lens, a 6" and an 8" reflecting telescope, and in wartime 3000 roof prisms with better than 98 percent acceptance rate, postwar, two 10" paraboloids, three 14" flats, about 6/7 of a Maksutov telescope (now nearly finished, and so are several other "Maks") How he went about doing the two 36" mirrors, what methods he used, should interest all fellow amateurs, particularly those who secretly harbor hopes of someday making a larger than average mirror, which means nearly everybody The account is especially valuable because Broadhead does not try to hide or minimize his mistakes He delivered the mirrors, better than specifications called for and a month sooner than they called for, and these earned Professor Strong's comment and OK to quote "We are just plain pleased, from the ground up"

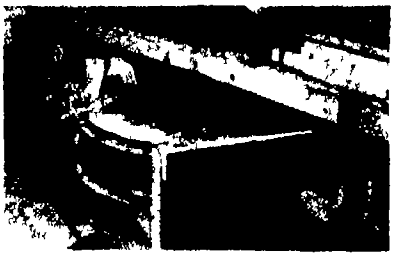

Figure 2 Rough Draper machine

Offhand, these looked like dead-easy mirrors Broadhead's cellar shop, 12' x 36', the neatest, brightest, and cleanest we have seen, affords a lathe, drill press, metal shaper, grinder, electric welder, gas crucible furnace, and room Most of these proved to be essential The less than full precision tolerance did not please but disappointed Broadhead, as it would any true amateur, but there were offsetting headaches and uncertainties also one certainty—the 90-day delivery limit Hence, all in all, the job contained enough adventure to interest Here are some excerpts from Broadhead's progress reports

"Have to build a special machine (Figure 2) Vertical spindle of 2" shafting on top of which is a round mirror support welded up from ½" boiler plate, with radial ribs and braces (Fig-

Figure 3 Welded mirror support

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ure 3) Very rigid 24" grinding tool (Figure 4, left) faced with glass blocks as in Strong's book page 44, rotated by a ⅛ h p motor Main oscillating arm of two-by-fours driven by a separate 1/3 h p motor Tool on top I have an ammeter in the driving motor circuit as a guide and warning to any approaching sticking of grinding tool, since a stuck 24" tool wouldn't be funny

"Polisher (Figure 4, right) 31" diameter, made of ½" boiler plate, radial fins welded on its back side Face has ¾" pitch layer, 2" facets Takes 150-pound pull to budge it Weighs 180 pounds

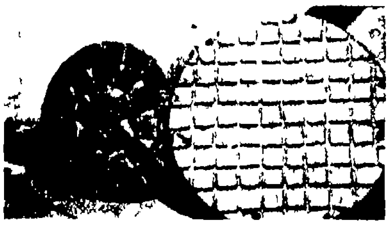

Figure 4 Grinder Polisher

"For knife-edge test on the 200' course I located image of a 1/64" pinhole with a big piece of cardboard Found I had hit the 200' radius within specified limits first whack, using a 22" spherometer I made (Since I didn't have a 22" flat with which to set its zero point I set it at zero on the concave mirror and then on the fitting convex tool The difference, divided by 2, gives the desired sagitta and that with double accuracy) But there isn't much to see at the knife-edge Usually the convection currents make the image look like a three-alarm fire (Figure 6, right, reproduced at exact size) One night, just before a rain, the air was steady enough for me to see the figure However, I don't try to use the knife-edge as a figuring guide Instead, I use an 8" test plate and study the interference fringes between it and the mirrors I use the shape of the circle of confusion merely as a rough indication of astigmatism (Figure 6, left) Incidentally, I may bring on broken arches from lugging these 140-pound mirrors upstairs and outdoors to test them, and neuresthenia from lugging them in again for fear of dropping them

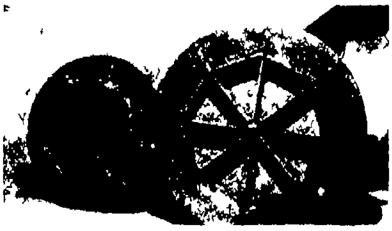

Figure 5 Welded tool backings

"While grinding the 36" I gave the 8" test plate one go on it for each grade of abrasive, then polished the mirror a bit to see whether the spherometer was giving me the right answers Then I polished the test plate, trusting to experience to get a sphere So, actually, I got the test plate right by using the spherometer in a roundabout way Of course it would be practically impos-

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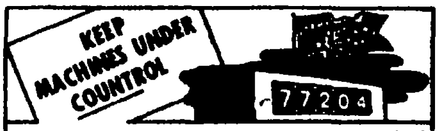

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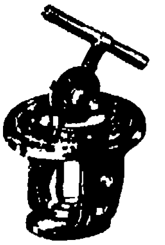

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sible to test an 8″ test plate at 200′ radius, at least much more difficult than the way I took

"At present No 1 mirror has a maximum variation from spherical of ¾ wave in any 8″ area No 2 is ground through 400 Carbo Had it polishing once but got a bad scratch Mirror so light (except when you are lugging it around) that it is lifted by the grinding tool by suction when tool is lifted with a chain fall After a lot of teasing it suddenly lets go, the mirror clumps down ½″ or so, and the tool seesaws and thumps the mirror Heart failure every wet"

THREE WEEKS later, job finished, Broadhead completes his report, and in what follows he very frankly points out the main mistake he made, and "don't we all?" (If the log book for the 200″ mirror is ever published *in toto*, would you be critical if mistakes that must have been made by the human beings who made it were similarly set forth with candor, or would you expect the makers of *that* mirror to be different from other humans? If so, why?)

"Radius of mirror *A* is 198 3″, that of *B* is 199 1″ Circle of confusion obtained

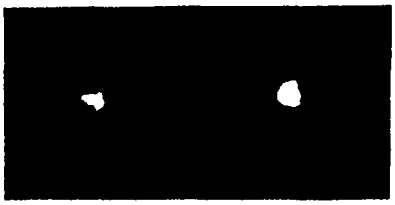

Figure 6 Astigmatism Bonfire

by 2/3 diameter grinder and 5/6 diameter polisher and proper strokes came well within ⅛″ tolerance specified for single reflections without recourse to local figuring One modification of my previous ideas and technique that I learned—though it should have been obvious—is that my rigid tool technique is useful only up to the point where the tool is as stiff as the work I erred by making the grinding tool probably several times as stiff as the glass, and thus unnecessarily heavy, and this in turn bent the glass and gave greater astigmatism troubles Yet, to avoid astigmatism, I was trying to support the glass perfectly I could have arrived at a better balance of factors If I had it to do over again I could, if it served any purpose, make the mirrors much more easily, using the original 2/3 tool for roughing a 5/8 tool of aluminum for fining, and a similarly light lap backing for polishing (in order that, if it became necessary to return to grinding, the glass blocks need not be re-cemented on the tool)

"Although the mirrors are well within all specifications, it is instinctive for a TN to want to continue till his best level of workmanship is reached, also until every shred of information has been wrung out of the job In this sense, such a job as this was disappointing

"I found that the most convenient bed for the mirrors was the long-used Brussels carpet, but that the support given by it varied considerably with

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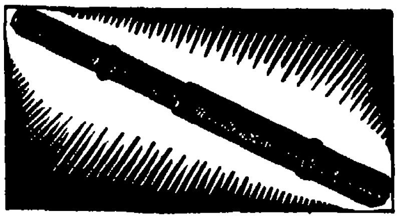

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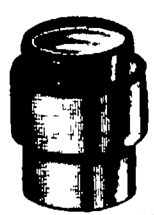

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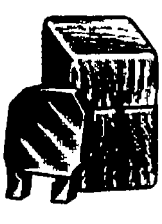

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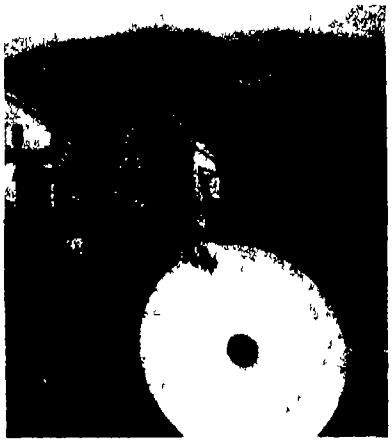
the direction of the nap Here rotation of the mirrors at the end of each wet helped, but on the rougher grades, say 180, the variation in spherometer readings on diameters at right angles, due to the lie of the nap, was about 0 0005" in a single wet At 600 emery this was reduced to 0 0001" and after several wets of UO10 Garnet Fines I could no longer detect this astigmatism with a spherometer Yet, after a short polish, I could easily detect plenty of it with the 8" test plate It slowly reduced during work with the 5/6 lap, but still was much in evidence even after the polish was complete and the circle of confusion reduced to about half the tolerance specified The advantage of the Brussels carpet is that the variation in the support is fairly constant, whereas with a hard support the mirror touches at only three wandering places

"Had this been an astronomical job the outstanding astigmatism would have been ratable as heavy, and would have called for slower methods and thicker blanks The thin glass was used simply to save costs in laboratory research with these mirrors that did not call for a more expensive set-up "



Broadhead in shop togs

COMMENTING on this job, Professor Strong stated "The difficulty of making these thin mirrors was an unknown I even had to make some computations before I was satisfied that such a mirror would hold a figure once it was given one, and I found that it wouldn't hold a figure unless it was used in a fixed, vertical position Very thin mirrors can be used in a fixed vertical position if they can be given a figure That was my joker Who could give such thin glass a figure? I was convinced that it could be figured by someone with imagination, skill, and enterprise, but that conviction was based more on faith than on facts Now we have the facts, and 30 days ahead of schedule The circle of confusion for the final image, after four reflections, two from each mirror, was less than ¼" in diameter The light in the final image of a Western Union point source, after a 600' travel and four reflections from Broadhead's two mirrors, was a hard core of about ⅛" diameter, and practically all the light fell within a 5/16" circle For our needs this is perfect performance "

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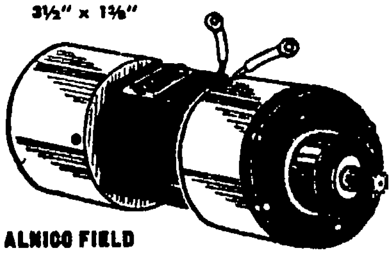

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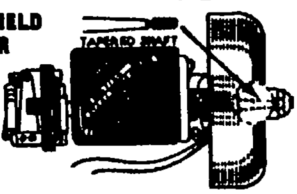

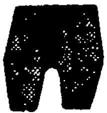

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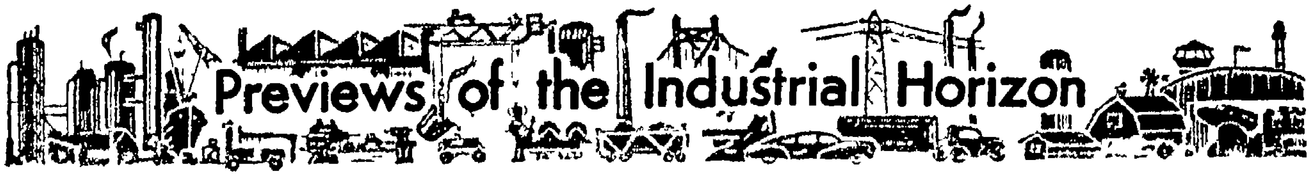
Previews of the Industrial Horizon



By A. P. Peck

PROTECT YOUR BRAND

Of outstanding interest and importance to all producers of goods which are or may be protected by trade mark registration is the new Lanham Act This latest Federal Trade Mark Act was signed by the President last year and becomes effective on July 5, 1947

The Lanham Act will, in general, coordinate the presently scattered federal provisions relative to trade marks In bringing our trade mark statutes up to date, it will gear protection of brand names and other marks to modern business needs and will reduce immeasurably the possibility of unfair competition By providing that registrations may become incontestable after five years of continuous use, the Act will remove much of the uncertainty which exists under present conditions

Because of the broad scope of the Lanham Act, it is impossible to do more than make this mention of some of its desirable features here However, an analysis of the Act and of its effect on business has been prepared in booklet form by Sylvester J Liddy, Esq , of the New York Bar We are happy to be able to offer gratis copies of this pamphlet as a service to interested readers Simply request a copy of Mr Liddy's analysis of the Lanham Act on your business letterhead, and it will be sent by return mail

MORE HUMAN ENGINEERING

Just after our note, "Man's Humanity to Man," this page, May 1947, appeared, Eugene Holman, president of Standard Oil Company (N J) held forth on the same general subject So pertinent is Mr Holman's statement, and so indicative is it of a definite trend in industrial-worker relations, that we quote it to some extent

"A considerable part of our future planning," said Mr Holman, referring to his own organization, "will have to be centered in the field of human relations Thrift plans, annuity benefits, and insurance are enjoyed by a very great majority of our workers We regard these things as definite obligations to the employees, and we shall continue to meet them But security alone is not enough Beyond that we must work to increase the opportunities for the growth and advancement of the individual throughout the industry "

Here indeed is recognition on the part of one of the biggest of big businesses that mere material reward is not sufficient for even the lowliest of workers Incentive payments, as we have dwelt upon before, are highly desirable in the industrial scheme of things They produce results But they do not produce—alone and by themselves—*all* the results that can be had from employer-employee co-operation The boss must realize that the worker—every last one—is a human being He must come to the realization that unless employees are happy and contented, their mutual profit will not be at the optimum. And it must be realized by all that this optimum cannot be attained when that "mutual profit" is thought of only in terms of dollars and cents

When incentives in business comprehensively encompass higher wages in return for greater output *plus* an opportunity for the human ego of each worker to expand and blossom, then—and then only—will man's humanity to man yield its greatest fruit in this complicated civilization of ours "Do unto others " and the rest of the Golden Rule looms larger on the industrial horizon than ever before Those men in key industrial positions who realize the implications of it are those who will profit most—materially and otherwise

CONSUMER TIME STUDIES

Producers of consumer goods may well take a page from the book of Proctor Electric Company, manufacturers of automatic electrical appliances and particularly of the so-called Never-Lift iron, billed as a boon to the housewife who does her own ironing Through a series of time and motion studies, Proctor has evolved a system for home ironing which reduces fatigue to a minimum and at the same time speeds up what must be an onerous if necessary household chore These studies show the housewife a "scientific" way to get through this job with the fewest motions and with the least possible consumption of time If more manufacturers of household appliances and the like would take the trouble to inaugurate similar studies, and thus be able to show definitely how users could benefit by the advantages offered by their products, everyone's path would be made a bit smoother And we don't mean the smoothness attained by removing the dust from cigarette tobacco'

UP IN THE AIR AGAIN

If there ever was an industry with its ups and downs, it is the aviation industry as it is today No matter how you look at it, the aircraft industry is still in the luxury class The only possible purchasers of large transport planes—with a few and unimportant exceptions—are the airlines The possible purchasers of private planes are the general public

Let's look at these two markets separately First, the airlines According to the president of United Airlines, present plans for the airlines in the United States can account for the purchase of new planes to the number of only 1200 units during the next five years Two hundred and forty units a year are not going to keep our large-aircraft production possibilities in business unless the Government manages to coordinate its military requirements with those of the privately owned airlines or vice-versa If this can be done, so much the better for all concerned, if it cannot, look for trouble on the transport-plane production line

The other aspect of the airplane situation concerns private planes—personal planes, if you will For a number of years this market has been touted as the saviour of the aircraft industry Now, at the time of writing, it appears that the bottom is dropping out of this section Where second-hand light planes sold a few months ago for at least as much as the list price of a new plane, they are now a drug on the market Already, of the bakers' dozen of light plane manufacturers, at least three have quit, with the probability that more of them will go out of business in the near future The reason too many people have been sold on the idea that private light planes are going to follow in the path of the automobile—at least one in every garage But prices have remained high, maintenance is a problem, and airports are too far from home

Private flying, of course, will always be with us But to what extent it will replace the horse and buggy—and even the automobile'—is still one of the headaches of the private airplane industry

WILL WE HAVE LIGHT CARS?

UNFORTUNATELY for the development of the light car in the United States, much of the public thinking has been concerned with "keeping up with the Joneses" On the other hand, in England, where motorists for many years have been more mileage-conscious, the light car has progressed rapidly Just over a year ago, General Motors announced plans for a light Chevrolet, not long after, Ford followed suit Now, both companies have apparently shelved their plans for trying these markets, feeling it "inopportune" to divert materials and man-power to the production of light cars which will produce high mileage per gallon of gasoline Such moves leave Crosley alone in a market which can well be developed to a leading position in the low-priced car market if it is followed up by intelligent application of technological know-how to immediate production problems

ON A PHOTOGRAPHIC NEGATIVE

OF INCREASING importance on the industrial horizon is the versatile tool that is offered in the shape of photography in all its phases The photographic negative can "stop" motion, speed up motion, reveal the ultra-small, reduce the super-colossal, compact filing space to an irreducible minimum, record the vision of the probing eye of the X-ray, tame the spectrograph, replace the repetitive labors of the layout man, and do a thousand and one other jobs in industry, limited only by the ingenuity of man

To capture the spirit of photography as it applies to industry, this issue presents the first of a series of articles on what Eastman pleases to call "funtional photography" But whatever the name—we call it "industrial photography"—the results are the same a recording medium of high accuracy and infinite possibilities If our articles stimulate thinking along industrial photographic lines, they will have served their purpose Readers are invited to contribute new thoughts, new methods, new ideas

More on this later A high-speed X-ray motion picture technique has been developed to study the interior of the body in motion Dwell for a moment on the translation of this process into a method of finding out what happens during lost-wax casting, flame-pressure welding, plastics and metal extrusion —during a thousand and one other industrial processes that today are followed empirically Truly the X-ray, coupled with the motion-picture film, offers a means of recording research progress which cannot be surpassed, it has equal possibilities on the production line

NYLONS FROM THE FARM

ELSEWHERE in this issue is announcement of the possibilities of production of nylon for hosiery from farm wastes, natural gas, and so on One of the questions that is going to result from this report, without doubt, is How many pairs of stockings can be made from a bushel of corncobs? The answer is None What the chemist actually does is to produce from corncobs just one of the chemicals which go into nylon Other chemicals are equally important So is plant investment Thus, while it may be said that a bushel of corncobs can yield enough hexamethylene diamine to go into about 40 pairs of nylon stockings, it must be remembered that this bushel of corncobs represents millions of dollars of plant investment, the technical knowledge and skill of hundreds of highly trained research and development men, and the work of thousands of others in a great variety of jobs Back of the announcement of nylon from corncobs lie 12 years of study and a million dollars or more spent on research, plant plans, and expansion of existing industrial facilities

STRAWS IN THE WIND

WIDE use of plywood is booming prices, but if quality of this composite wood, as well as of other forest products, is not maintained, the wood industry is bound to suffer in the long run Rubber from the Orient is coming back in huge quantities, synthetic rubber production is sky-high, we need our synthetic rubber plant for national protection, we must walk lightly and carry a big stick (that was another Roosevelt) to make sure that we don't come out on the wrong end of the deal As predicted in this column, farm machinery manufacturers—International Harvester in particular—are invading the "small farm" machine field with equipment which is still running, production-wise, far behind demand Among the devices being offered agriculturists are labor-saving post-hole diggers and beet and potato harvesters Producers of equipment for floodlighting are riding a wave created by the sports-loving section of our citizenry, recreational facilities ranging from baseball to archery and from rifle shooting to swimming and tennis and horseshoe pitching are absorbing millions of dollars worth of floodlights

50 Years Ago in . . .

(Condensed from Issues of July, 1897)

PNEUMATIC MAIL SERVICE—"Some thirty years ago the late Alfred E. Beach, of the Scientific American, exhibited in this city a working plan for the carriage of mail matter rapidly from branch stations to a central office by means of pneumatic tubes. He also experimented successfully on the idea of conveying loose letters in a smooth tube by a strong current of air, regarding it as an improvement over the old plan of having separate cars The idea is in practical use today in the many mail chutes found in tall buildings, where gravity supplants air as a propelling force Now, a generation after, a similar system is to be carried out in this city, permission having been granted by the Legislature to the United States postal authorities to lay pneumatic tubes in our streets"

LABORATORY WORK—"At the present day the systematic study and advancement of any physical or natural science, including the medical sciences, requires trained workers who can give their time to the work, suitably constructed workrooms, and equipment with all the instruments and appliances required for special work, a supply of the material to be studied and ready access to more important books and journals containing special literature of the sciences All of these conditions are supplied by a well equipped and properly organized modern laboratory Such laboratories are, with partial exception of the anatomical laboratory, entirely the creation of the present century and for the most part of the last fifty years They have completely revolutionized during the past half century the material conditions under which scientific work was prosecuted"

PHOTOGRAPHING RAIL DEFLECTIONS—"An arrangement for enabling the deflections of rails, bridges, etc, under moving loads, to be photographically recorded consists of a camera, of which the plate holder is fitted to slide across the back by clockwork, so that a series of successive images may be taken upon one and the same plate at uniform intervals of time The rail or beam to be observed has attached to it a brilliantly polished bead, which is photographed as a point of light, and the successive images of this point show the deflections A second lens causes the images of a stationary point to be photographed upon the same plate in a line just below, thus furnishing a base line for comparison"

UNDERGROUND—"The latest addition to the system of underground railways in London will probably rank as the most important of all these lines before it has been very long in operation. The road will be about sixty-five feet below street level, and will be carried in two separate and parallel tunnels—a similar plan to that adopted in the Southwark underground railway in the same city Each station will be served by two elevators and two stairways The new undertaking will have especial interest for this country, from the fact that the electrical equipment of the road itself and of the extensive system of elevators by which it will be served will be furnished by American firms"

WINTON CAR—"After the recent unsuccessful motor carriage competition in England, it is satisfactory to note that several firms in the United States are now really in a position to make and deliver motor carriages For a long time it was impossible to buy a motor carriage at any price, but, happily, this day has now passed The horseless carriage which we illustrate is made by the Winton Motor Carriage Company, of Cleveland, Ohio On September 1, 1896, Mr Winton, the president and master mechanic of the company, completed his first motor carriage It has been in constant use since that time in all kinds of weather and over all sorts of roads The motor and driving mechanism, bestowed in the body of the vehicle, are self-lubricating The ten horsepower motor of the hydrocarbon type is almost noiseless, odorless, and free from vibration The fuel is gasoline, seven gallons being carried on the carriage"

KITE BALLOON—"The usual form of balloon adopted by all the leading armies of today is the pear-shaped, captive balloon, connected to earth by means of a steel rope A new form of gas reservoir has, however, been devised by the German Captain Parseval, which enables its occupants to use to a full extent and under all circumstances the excellent observation opportunities that an ordinary balloon offers only in a dead calm The principle on which the new balloon is built is the well-known action of a kite Its shape is that of a cylinder with hemispherical ends"

100 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of July, 1847)

LONG DISTANCE TELEGRAPHY—"New Haven was put in telegraphic communication with Toronto, Upper Canada, recently, and messages were instantly exchanged between the two cities the entire distance being nine hundred miles! The experiment was a most successful one, and the distance was overcome with as much apparent ease and promptness, as between New Haven and Hartford"

FEMALE LABOR—"Not far from $5,000,000 are yearly earned in Massachusetts, by females employed in the various factories and manufactories of straw hats, &c About 40,000 females are thus annually employed"

PRE-FABRICATED CHURCHES—"A London Church-builder provides wood and iron churches for transmission to the colonies He offers a church with stained glass windows, bell, &c., capable of seating 800 persons, for 500 guineas But, if you cannot afford to buy a church, he will lend you one 'on hire'"

RAILROAD SPEED—"The first locomotive built by Stephenson ran no more than five miles an hour, and it has been said that this celebrated engineer made the assertion, which he has since lived to condemn, that 10 miles an hour was a speed which was scarcely possible to obtain and which never could be surpassed. Last year Mr Brunell ran his engine at 60 miles an hour, and on the Western Railroad from Boston, this same speed has been attained in several instances"

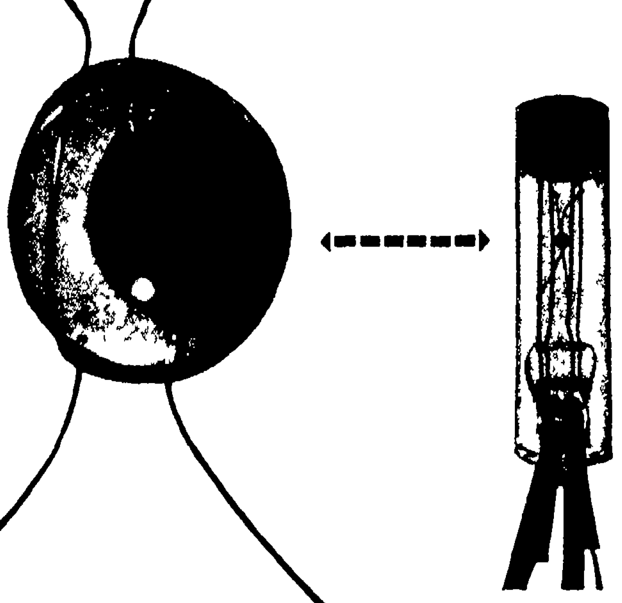
The Eye That Never Closes

You are looking at a thermistor — a speck of metallic oxide imbedded in a glass bead hardly larger than a pin head and mounted in a vacuum. The thermistor was developed by Bell Telephone Laboratories to keep an eye on the amplification in long-distance telephone circuits.

When a thermistor is heated, its resistance to electric current changes rapidly. That is its secret. Connected in the output of repeater amplifiers it heats up as power increases, cools as power decreases. This change in temperature alters the resistance, in turn alters the amplification, and so maintains the desired power level. Current through the wire at the left provides a little heat to compensate for local temperature changes.

Wartime need brought a new use for this device which can detect temperature changes of one millionth of a degree. Bell Laboratories scientists produced a thermistor which could "see" the warmth of a man's body a quarter of a mile away.

Thermistors are made by Western Electric Company, manufacturing branch of the Bell System. Fundamental work on this tiny device still continues as part of the Laboratories program to keep giving America the finest telephone service in the world.



BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Scientific American
JULY • 1947

UPWARD REACHES SCIENCE

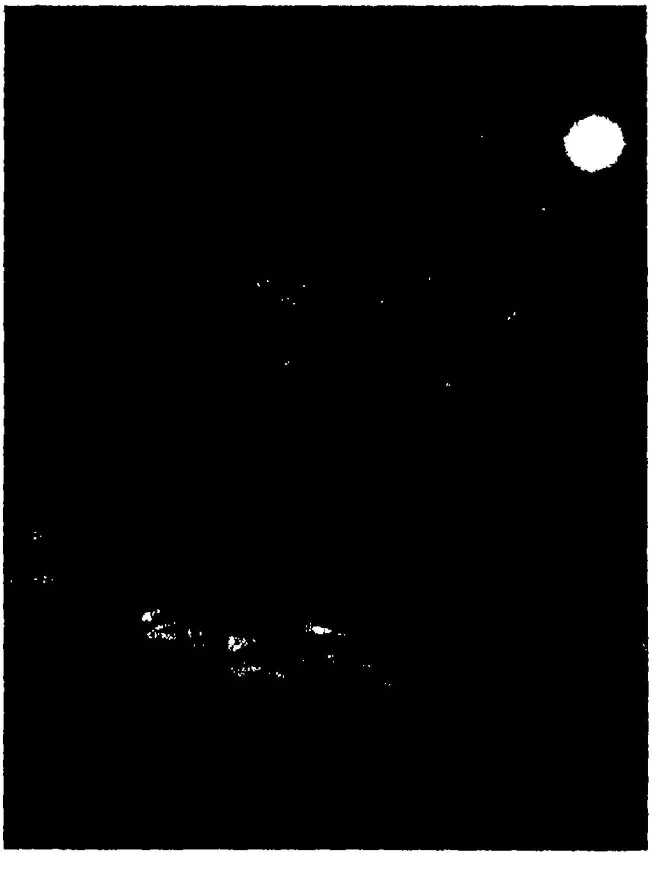
By

Brigadier General David Sarnoff

President,
Radio Corporation of America

Recent Scientific Developments Have at Last Opened for Exploration The Vast Fields of Untapped Resources Which Lie Skyward From the Air, From the Stratosphere, From Even the Moon and Planets, Man Will Gain Knowledge Hitherto Undreamed-Of Proper Use of This Information Can Give Impetus to a New Era of Progress and Enlightenment

"... may even learn how to use the moon and the planets as radio sounding boards"



SCIENCE emerged from the war as a powerful force that created new instrumentalities and promised many others for use in peace-time, if man would only direct his thoughts to peace instead of war and his scientific research to higher elevations

During the war, science reached skyward and a miraculous invention called radar saved England in the blitz, guided bombers to their targets, doomed the U-boat, and aimed the big guns of battleships to fire with deadly accuracy, even in the dark Aside from radar, post-war dictionaries have many new words that spring from radio and electronics, such as sonar, shoran, teleran, and the proximity fuse

At the end of World War I, it was vividly apparent that scientific research was a vital factor in our industrial progress As a result, it grew ten-fold between 1920 and 1940 Within the past two decades, in television alone, the radio industry spent more than $20 000,000 on research That investment called for faith, for initiative, and for young men with new ideas

Unified research on a national scale, costing $2 000,000,000, produced the atomic bomb Scientists themselves were amazed at the speed of the development, having believed it would require 20 years or more to achieve such results Their calculations, however, did not take into account the impact of war which produces speed, direct action, and concentrated effort

Peace also can benefit from similar concentration on certain pressing problems For example, what would result from even $100,000,000 wisely spent on cancer research? If research produced a cure for cancer, it would save more lives than were lost in the war

Research into the unknown is a great adventure It should be encouraged if American scientists are to blaze new trails in life, as the electron microscope has done in revealing the microscopic world which surrounds us From a study of infinitesimal organisms and elements, from unseen rays and waves which permeate our bodies, we may find the answer to our future in the Atomic Age The tiny, invisible things of life are only beginning to reveal their importance

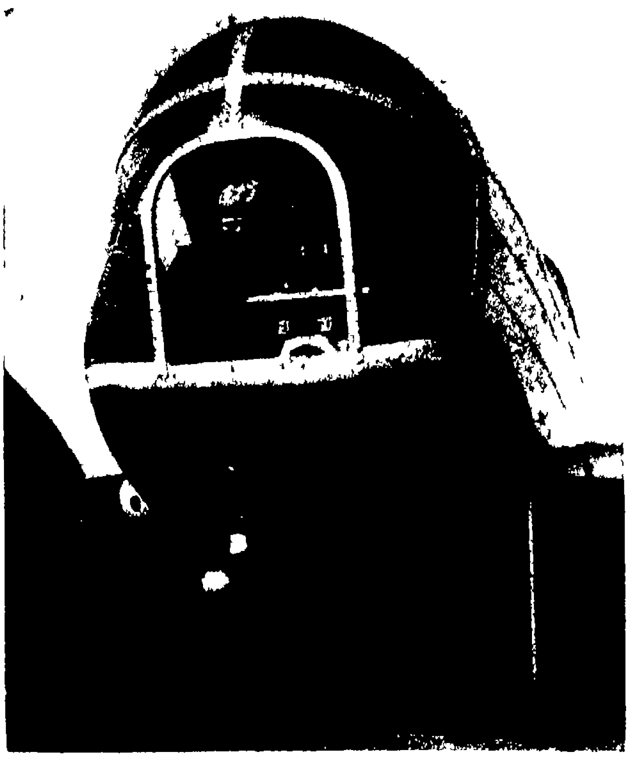
• LOOKING AHEAD •

Improved television systems for industry where direct human observation is impossible or impractical

Wide-area high-frequency broadcasting by the use of moon and planets as reflectors

Accurate weather forecasting and control as a valuable tool of industry and agriculture

Radio duplication developed to the point of a regular radio postal service



Air borne television camera. "Man will be able to look around the world by television"

The electron is the key to the world of the infinitesimal.

We have long associated power with great size, but we are now beginning to realize that tiny invisible things, such as the electron and the atom are the axes on which our very existence whirls.

RESEARCH A BULWARK — Science today has the benefits of organized, industrial research affording inventors every facility, co-operation, and comfort for work and for study. Without it, World War II might have been lost. Industrial research conducted by private enterprise is a bulwark of the United States, it promotes victory in war and assures progress in peace. It is a safeguard of civilization.

We who are veterans in radio, as well as those in other fields of scientific endeavor, are continually encouraged by the knowledge that there are as many new frontiers of research today as there were 100 or 1000 years ago. The crossing of one frontier in science always leads to another. Each discovery, each invention, spearheads a new and undreamed-of advance. Through radio and electronics, for example, scientists now believe that some day they may be able to detour storms, to dissipate clouds and fog, to produce rain and snow, and thus measurably to control the weather.

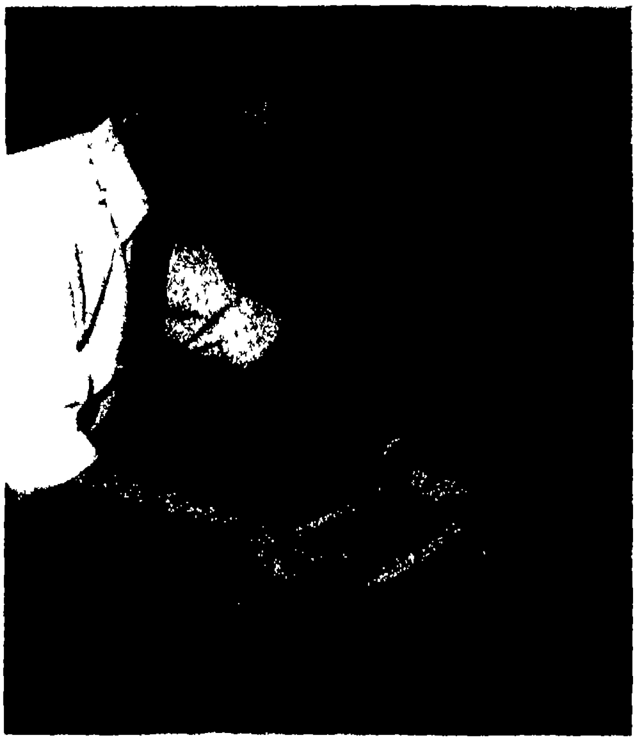
The frontiers of science spread above the earth and throughout the universe, far into unfathomed space. Scientists, especially mathematicians for centuries have been enchanted by the immensities of time and space by gravitation, by the propagation of light, the theory of relativity, by electromagnetic radiation, and by radioactivity. But laymen have looked into the heavens and referred to "the emptiness of space." They have described the vacuum tube as a 'glass bottle full of nothing." Now, thanks to science we know that space is not empty, and that a vacuum tube is far from being filled with "nothing."

Radio and electronics have given space and the vacuum tube a new meaning. Scientists are learning how to snap the switch that will bring them the sounds and pictures of the universe. They are challenged by science to keep their eyes on the stars. Both astronomers and radio scientists now scan the blue dome of the world. The sun rises and sets with spectacular brilliance, yet it is a drama enacted as quietly as if performed with an electron tube, which also merely seems to glow! But within that tube there may be a voice from Melbourne, news from London, or music from Paris. Turn on a television cathode-ray tube, and its face lights up with a picture of the United Nations meeting in New York or the 80th Congress opening in Washington, or the Army-Navy football game in Philadelphia. No longer is the electron tube full of nothing!

WIDENS MAN'S SENSES — New tools of science are opening man's eyes in the realm of the invisible. But we need not see to be convinced that science is a vivid reality beyond the range of human sight and hearing. Science works in no such narrow spectrum. We perceive evidence of this in new forces which extend the range of man's optic and auditory nerves. By radio, man now can hear even a whisper or the buzz of a bee across the seas, through the electron microscope he peers into the realm of the molecule and the atom. By television, he sees beyond the horizon.

While these are inventions that open new vistas and widen man's earthly range beyond the microscope and telescope, we have ample proof that these forces are not confined to the surface of our planet. This world of ours actually spins in a boundless, inexhaustible laboratory. Radio beams flash through the ozone layer to probe through the dust of interstellar space. The plane that soars to 40 000 feet to learn the secrets of cosmic rays, or the rockets that carry automatic recording instruments more than 100 miles into space, are but feeble short-distance efforts of man to pierce the upper atmosphere.

Planes and rockets are mechanical devices which meet the resistance of Nature. But radio, radar, and television, travel on wings more closely allied with Nature. They will encounter little opposition as they mingle with meteors, nebulae, and galaxies. Radio, like sunlight, travels 186,000 miles a second. Indeed, radio is a relative of light, and the shorter the radio



Radiophoto equipment. " . . . faster than any aircraft or even mail-carrying rocket." Right: The electron microscope. " . . we may find the answer to our future in the Atomic Age"

waves, the more apparent their kinship becomes

The radar "peep" that echoed from the moon was more than a faint signal of hope to radio scientists and astronomers To them it was as important as the first feeble transatlantic signal to Marconi's ears when he plucked the letter "S" from the air That flashes of three dots in the Morse code told him that world-wide radio communication was possible Similarly, the radar signal from the moon proved that man might some day reach out to touch the planets, it revived speculation on interplanetary communication and inspired great hope for interstellar scientific exploration With electronic computers, sensitive photoelectric cells, and infra-red eyes that see in the dark, the mystery story of the upper altitudes will become available for man to read The telescope with its giant mirrors is no longer the only exploring eye for discovery above and beyond the earth

Radio and radar have proved that space is not empty and we know now that it is accessible to man He may even learn how to use the moon and the planets as radio sounding boards and reflectors, to bounce or relay broadcasts and to mirror television pictures The moon is only 240,000 miles, or radiowise less than two seconds away It looks like a good radio concession! We may find future broadcasters staking claims for Saturn, for Jupiter, or for Mars and Venus as well

YOUTH AS A RESOURCE — Let no youth today deplore the lack of opportunities Look up at the Milky Way and behold a myriad of challenges. Science through radio and radar is providing new tools with which to explore electronics, chemistry, and physics

New resources are to be found in space which may be captured and brought to earth, to be harnessed or synthesized for the welfare of mankind

Just as we have succeeded in releasing atomic energy from uranium, we must release the energy from the minds of our youth In the fertile brains of American boys and girls are the master keys to the future We must stimulate and encourage youth if this nation is to have health, prosperity, and security With its natural interest in science, youth is one of America's greatest national resources

Great industrial laboratories will be built, splendidly equipped, and on sites conductive to clear thinking, but they will be worthless, no matter how great the funds behind them, if trained men of research do not work within their walls There is no substitute for brains Men, not tools, are the lifeblood of research

The chemistry of the atmosphere with its nitrogen, carbon, oxygen, hydrogen, the "noble gases," and perhaps other yet to be discovered elements or particles, represents intriguing continents for exploration We now hear of a new component—the meson —believed to result from the interaction of the primary cosmic ray with atoms in the atmosphere This so-called meson is estimated to have a mass 200 times that of the electron Herein may exist a clue to devising a new source of energy to be harnessed and controlled by man

BOUNDARIES IGNORED — Radio now spans the gaps of the hemispheres, leaps frontiers, ignores boundaries, and cannot be stopped by any man-made political "curtain" For radio goes everywhere —and through word and picture can bring information and understanding to all peoples of the world

Already we are on the threshold of individual radio communication A motorist on the streets of New York may talk with a friend in Bombay, or with a relative on a ship somewhere on the Seven Seas The day is coming when radio will speak man to man, and television will place them face to face in New York, London, or Shanghai All this is the essence of "One World."

Man will be able to look around the world by television with the same facility that he now listens around the world by radio Historic events will no longer encircle the earth only as sound. They will be seen and heard as sight and sound in tandem

Nor should we think of television only as an optic nerve over which entertainment and information flow pictorially, for it has many other uses which may even dwarf its performance in the home and theater Wherever transport needs vision, television will help to provide it The airplane will see by television and radar, so will ships at sea Similarly, wherever industry needs an eye, television will provide it. It will watch over industrial processes and machines, it will go into places the human eye cannot reach Fireproof eyes will be put into furnaces to scan chemical reactions Tunnels will have these radio eyes as will conduits and mines

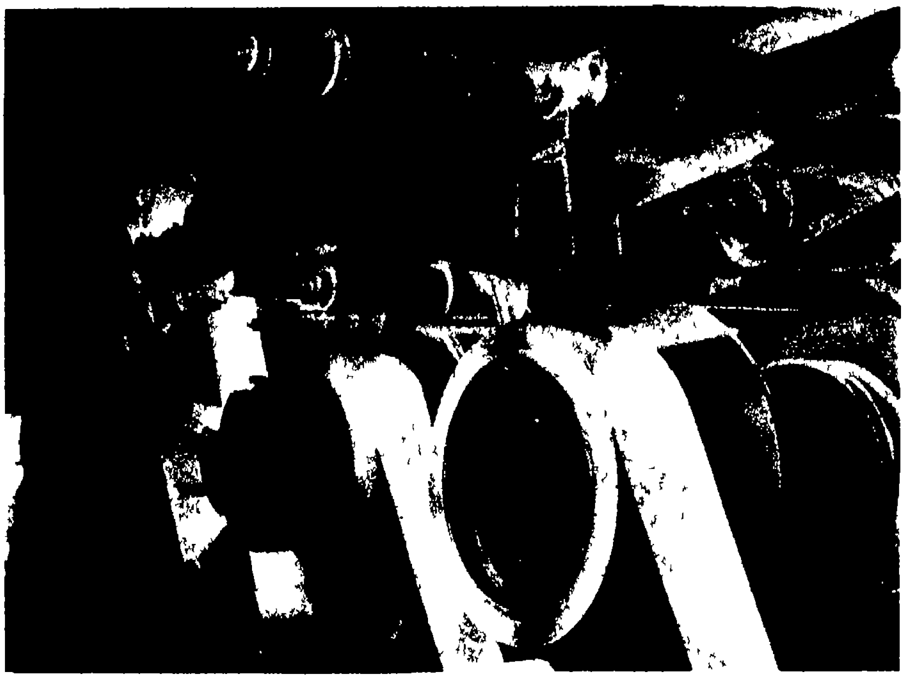
A radio signal traveling 186,000 miles a second, faster than any aircraft or even a mail-carrying rocket, circles the globe in one seventh of a second Before a mail-laden plane could get off a runway in Australia, radio could be delivering mail from Melbourne—in Washington or London In the future, a person will write a letter or a message that will be put on a belt moving in front of a television eye In a split second that letter or message, exactly as written, will appear in England, South Africa, or China There, it will be automatically reproduced by a photographic process for delivery in minutes—not hours as required by even the fastest airplane

SEALED LETTERS BY RADIO — Eventually we may be able to take a sealed letter or document and flash it across the hemispheres without opening the envelope That again is a television-possibility—and it's not too fantastic If X-rays can look through the human body and through steel, why should it not be possible for the television eye to look through a paper envelope? This would make possible a radio mail system

Science is at man's command He can use radio and radar to guide rockets and bombs loaded with atomic warheads, he can equip these winged missiles and robot planes with television eyes focused on great cities as targets of destruction Or he can use radio, radar, television, and atomic energy for peace-time pursuits in commerce, industry, and home-life that will contribute greatly to "One World" in which people everywhere may live together in understanding, happiness, and friendship

Mobile television unit. "Historic events will no longer encircle the earth only as sound. They will be seen and heard as sight and sound in tandem"

Stainless steel strips are recoiled at an American Steel and Wire Company mill, and are interleaved with surface protecting paper fed from spools near floor



Courtesy United States Steel Corporation

New Fields for Stainless

By Fred P. Peters
Editor in Chief, MATERIALS & METHODS

Expanded Production of Stainless Steels, Coupled With the Development of New Types Having Improved Properties, is Bringing this Group of Metals to a Position of Ever Increasing Industrial Importance

ANY MATERIAL which has expanded its output and increased its importance as rapidly as has stainless steel, must have much of interest to offer the manufacturer and designer. Indeed, new users are continually discovering special advantages in the various combinations of permanent beauty, rust resistance, special corrosion resistance, high-temperature properties, mechanical strength, fatigue life, high strength-weight ratio, and so on, available in different types of stainless. Many of the problems that limited stainless-steel applications in the past have been solved and most of the half-truths that were once accepted as gospel are now understood and kept properly within bounds.

Last year the production of stainless-steel ingots in this country amounted to 542,000 tons, and 1947 production is currently at an even higher rate. This means that stainless steel has achieved a position as one of the eight most important engineering metals in our economy, being surpassed only by carbon steels, low alloy steels of all types, cast irons, aluminum, copper, zinc, and lead.

Just a few years ago the American production of stainless was in the neighborhood of 250,000 tons per year, many authorities expect it to exceed 1,000,000 tons within the next few years. At this rate of growth stainless could conceivably become more important industrially than every nonferrous metal except aluminum, and would justify the contentions of those who regard it as the steel industry's answer to the vigorous challenge of the light metals for available markets.

DIFFERENT TYPES — By "stainless steels" is meant those iron-base alloys with at least 4 percent chromium content and up to 50 percent total alloy content. The best known members of the group are:

Cutlery stainless or "13-chrome," heat-treatable steels containing 12 to 14 percent chromium, little or no nickel, and fairly high carbon, "18 and 8," non-heat-treatable (austenitic) steels containing 16 to 19 percent chromium, 7 to 10 percent nickel, and as little carbon as possible, (the most important grades from the standpoint of tonnage production), "17-chrome," non-heat-treatable steels containing 16 to 18 percent chromium, little or no nickel, and as little carbon as possible, and steels such as "25-12," which contains 22 to 24 percent chromium and 12 to 15 percent nickel, is non-hardenable, and provides exceptionally high corrosion resistance and mechanical strength, but at higher cost.

It is generally agreed that the corrosion resistance of stainless is conferred primarily by the chromium present, secondarily by the nickel, and that carbon

Many components of jet engines are of heat and corrosion resistant stainless steel. Typical example is this model developed by Westinghouse for the Navy

Courtesy Electro Metallurgical Company

Stainless steel is used in these mine pumps made by Alloy Steel Products Company because of its corrosion resistance

detracts from corrosion resistance. In steels of the "18 and 8" type the carbon causes a particularly annoying type of corrosion weakness known as "intergranular corrosion" and its effect is counteracted through the addition of small amounts of columbium or titanium, steels so treated are known as 'stabilized' steels, because they are resistant to the conditions that would otherwise produce intergranular corrosion.

The most familiar condition of this type, and the one that has the most industrial ramifications, is the slow-cooling of the steel that occurs in a weld just after it has been completed. Chromium-nickel stainless steels that are to be welded should be "stabilized," otherwise they are strongly susceptible to subsequent serious corrosion in the areas adjacent to welds.

The stainless materials are available in all forms—castings, forgings, sheet, strip, bar, rod, tubing, and so on. Only a few manufacturers specialize in stainless-steel production (for example Allegheny Ludlum Steel Corporation, Carpenter Steel Company, Eastern Stainless Steel Company, Rustless Iron and Steel Division of Armco, Washington Steel Corporation, and others) although most of the large general steel producers (American Rolling Mill, Bethlehem, Carnegie-Illinois, Republic, and so on) and many smaller companies (Crucible, Firth-Sterling, Jessop, Sharon, Timken, and so forth) do a considerable (and increasing) business in stainless along with their other products. In addition there are several steel and alloy foundries making stainless-steel castings for the chemical, marine, and other industries.

The early uses of stainless steel were in cutlery where it served chiefly as a sort of non-rusting tool material, and in ornamental applications. Later came increasing use in the chemical and process industries and especially in the food and pharmaceutical fields, for equipment to process and handle corrosive materials or those which must remain free from container-contamination.

In the past few years stainless steel has found increasing favor by virtue of its mechanical properties. The cold-rolled stainless steels (or the newer precipitation-hardened grades) have among the highest strength-weight ratios obtainable from modern engineering materials, a circumstance which has led to their growing use in aircraft, railway cars, trucks, buses, and elsewhere. Machinery parts are increasingly being fashioned from stainless steel because of the material's exceptional fatigue resistance, as well as its general durability under a variety of severe service conditions.

WORKABILITY OF STAINLESS — But the major reasons for stainless' rapidly growing popularity with product manufacturers are the improvements in its workability which have been effected in recent years and the increasing familiarity with the material that manufacturers all over the country now enjoy as a result of war-time experience with it. For example, stainless steel was once classed as very difficult to machine Today, through the development of stainless steels containing small amounts of selenium or sulfur or bismuth, several "free-machining" stainless steels exist which compare favorably with other engineering materials in the speeds and finishes obtainable with them When these are used with tool steels, set-ups, speeds, and feeds known to be best for stainless (instead of using the same procedures applied to ordinary steel), results have been known to astonish those who remembered only the troubles encountered in machining stainless steel 10 or 15 years ago

Then, in the early days, there were many unfortunate "disappointments" with stainless steel, through lack of simple care in handling or maintaining it Thus it has only recently become fully appreciated that the extent to which stainless steel products are kept clean by their users is important to their permanent brightness and their corrosion resistance In one instance two store fronts trimmed with the same grade of stainless existed side by side One was washed whenever the windows were cleaned, the other was cleaned only by the rain and the slop-over from window washing At the end of ten years the regularly washed store front looked brand new, the untended trim was badly pitted and dull looking before five years had passed

PRICE NO DRAWBACK — The higher price of stainless steel, in comparison with ordinary steels, is no longer as serious a drawback as formerly, for with the carefully worked out but simple-to-apply fabricating techniques developed especially for stainless steels, their fabrication costs may often be less than they would be with mild steel This is because rust-prevention procedures and surface coating are eliminated, as are extra strengthening operations frequently applied to ordinary steel, such as heat treating or shot peening

Then, too, the development of new stainless-steel materials has opened up vast new fields of application for these alloys—fields that are expected to be of even greater significance as time goes on than they are now The free-machining alloys previously mentioned will loom increasingly large in the stainless picture and among engineering materials in general, for they overcome the greatest objection that has traditionally retarded stainless-steel's applications

The "stabilized" stainless steels, formulated to resist intergranular corrosion, especially after welding, will be supplemented shortly by commercial stainless steels containing virtually no carbon at all If the carbon content of the nickel-chromium types can be held below 0 03 percent, carbide precipitation and intergranular corrosion will not occur "No carbon" stainless steels were developed and successfully used in England a number of years ago, and a few American producers have such steels of their own now in an advanced stage of development This is the next important step to come in stainless-steel's progress and is being closely watched by all interested in the production and fabrication of these materials

EXTRA HIGH STRENGTHS — The new age-hardening grades of stainless are also expected to find new applications for these steels In the past the extra high strengths available in stainless-steel products have been built into the raw material by cold-rolling it But cold-rolled stainless steel, although possessing about the highest strength-weight ratio obtainable today, is more difficult and expensive to fabricate than annealed or hot-rolled sheet. With the new age-hardening grades, a fabricator may buy the soft-annealed stainless steel, fabricate it easily and cheaply, and then heat treat the formed product to develop strengths comparable to those of the cold-rolled material The new materials are unique in the three-way combination of high strength, maximum corrosion resistance, and workability they provide

• LOOKING AHEAD •

More fabricators needed to specialize in use of stainless steels Designers and manufacturers taking increasing advantage of unique characteristics of the metals Better understanding of the utility of stainless and of its workability . . Still other new stainless types for specific uses Gas turbines and jet engines will need even better super-alloys

Again, stainless-clad carbon steels, made by bonding surface layers of stainless onto an ordinary mild steel base, are extremely promising materials They provide the user with the combination of surface corrosion resistance and fatigue strength that are characteristic of stainless together with the low cost or good heat conductivity of ordinary steel Cooking utensils, for example, are among the products that will increasingly be made of stainless-clad steel

The super-alloys developed for high-temperature use in gas turbines, turbo-superchargers, and jet engines include several doped-up stainless steels The Timken 16-25-6 alloy, for example, which is one of the best all-around super-alloys so far developed, is really a 16 percent chromium and 25 percent nickel stainless steel containing in addition 6 percent molybdenum As reaction engines of these types come into increasing use, special stainless steels are certain to be widely used for many of their major structural components

THIN STRIP — One of the very latest innovations is the use of the Sendzimir cluster mill for precision rolling of ultra-thin stainless steel sheet and strip With the final bugs being worked out of the process at this writing, industry can look forward to a regular supply soon, of lower-cost, high-strength stainless sheet and strip in very thin gages

One of the problems the stainless-steel producers face, which industry as a whole could well solve to its own advantage, is the need for more fabricators who will specialize in stainless steel The demand for certain stainless products—especially hospital, restaurant, and household equipment—is far greater than existing fabricators can supply There is reported to be a substantial and profitable volume of business awaiting new or old shops who will enter or expand the field of fabricating (for example) such products as hospital equipment and milk pails made of stainless steel sheet

PLASTICS • in PAINTS

Paints, Varnishes, and Similar Wood Surface Coatings With Synthetic Resin Bases Can Be Formulated To Meet Requirements of Specific Applications. The Resultant Coats Offer a High Degree of Protection, Beauty, and Durability

By Charles A. Breskin
Editor MODERN PLASTICS

Courtesy Bakelite Corporation

Prime requisite for floor finish on indoor roller-skating rinks is high abrasion resistance

With the recent emphasis in advertising on the plastics content of paints and other wood surface coatings, the average man is prone to think of the use of plastics in these products as a new development. Actually plastics and synthetic resins have long been used in wood coatings. The *really new* development in the field, as a result of research, has been the increased knowledge of resin properties, and greater skill in the compounding of coatings to meet specific needs. Thus, it is not enough for the prospective purchaser to choose a "plastics paint." He must determine the specific resin contained in the coating and its proportion to other ingredients if he would obtain the one material best suited to his requirements.

There are several reasons for applying a coating to wood. The most obvious and universal motive is to achieve a decorative effect through pigmentation or a glossy finish. Resistance to abrasion is a less common reason, but one of importance in such special applications as bowling alleys and roller-skating rinks. In furniture designed for use in laboratories, a major consideration is resistance to acids and alkalies. One of the most important reasons, however, for coating wood is to protect it against the adverse effects of rapid changes in moisture content. Basically that is why it is necessary to paint a house.

AGAINST MOISTURE — Coatings protect wood against the adverse effects of rapid changes in moisture content by retarding the passage of moisture through the surfaces. When moisture enters or leaves through the surfaces faster than it can diffuse within the wood, inequalities in moisture content and in degree of swelling set up internal stresses. These stresses cause grain raising and checking at the surface, then cupping, warping and even splitting of the boards, unless they are fastened firmly enough to prevent this action. Weathering finally loosens fibers on the surface and permits the wood to waste away very slowly.

A coating, impervious to moisture and covering the wood on all surfaces, would keep the moisture content from changing, regardless of the degree of dampness of the surroundings but, unfortunately, no such coating has yet been developed. No coating, therefore, will alter the moisture content at which wood comes to equilibrium if it is given time enough. In most instances, however, the fluctuations in moisture content are relatively rapid, and a coating that retards the passage of moisture sufficiently limits the change in moisture content to a fraction of the change experienced in uncoated wood, thus keeping the wood closer to an average moisture content. Those are the conditions under which coatings furnish effective protection, and under which wood benefits most from their protection. It is much more difficult to protect wood adequately against cycles of exposure in which the damp and the dry phases are each of long duration and the transition from one to the other is gradual Flooring and furniture in houses that are heated in winter are exposed to such conditions

TYPES OF COATS — Coatings may be divided into two major classifications according to the extent to which they penetrate the wood Since wood is a cellular substance, at least part of the applied material nearly always sinks into the surface Paints, varnishes, enamels, and lacquers, often called surface coatings, do not penetrate very far, and form a layer of substantial thickness on the surface of the wood, varying from 1 to 3 mils In two-coat painting of new woodwork with house paints, the second coat will be 2½ to 3 mils thick A complete finishing system may thus range from 1 to 5 mils In contrast, there are "intra-surface coatings" such as wood stains, wood fillers, wood sealers, and water repellents which are expected to sink almost entirely into the surface, leaving little or nothing on top

The greatest degree of protection for wood is obtained from surface coatings Intra-surface coatings afford much less protection, though some of them furnish enough to be useful in the right places In recent years, there has been a vogue for exterior coatings for houses that display the natural grain and color of the wood, instead of concealing them as paint does Such intra-surface coatings as water repellents and wood sealers are generally used for the purpose, since the glossy finish of varnish is undesirable Though low in resistance to moisture-penetration, intra-surface coatings are effective enough to prevent weathering, provided they are renewed at frequent intervals Their main shortcoming is this lack of durability, for they generally need renewal at least once a year

Intra-surface coatings, on the other hand, have some important advantages They are cheap and easy to apply The treated woods stands rough handling during shipment and erection at the site, since there is no surface coating to be scratched or chipped This is also an advantage in the case of wood surfaces that slide over one another Despite their limited effectiveness, the intra-surface coatings appear to have much usefulness for the protection of woodwork It should be kept in mind, however, that they protect wood only against short-cycle fluctuations in moisture conditions

RESINS COMMONLY USED — *Alkyd resins* The most popular resins employed in compounding coatings are the alkyds Various type of alkyd resins have been used successfully in coatings for wood For example, the oxidizing type of phthalic alkyd is appropriate for use indoors where decorative qualities are of prime importance, rather than weathering or moisture-excluding characteristics When this resin is made with soya oil, it shows excellent color and gloss retention, and is widely used for so-called architectural white enamels These are the familiar high-quality synthetic white enamels produced for household use There are special modifications of this type of oxidizing phthalic alkyd resins which produce coatings that dry faster and have increased water- and alkali-resistance and hardness In general, however, such characteristics can be improved only at the expense of durability and color retention

Alkyds based on maleic anhydride have a wide range of commercial applications According to the end use, the resins are generally divided into two categories—the varnish type and the lacquer type The varnishes are widely used as household utility varnishes, and as vehicles for architectural white enamels They have good color retention, good hardness, and dry quickly, but they lack the durability which is characteristic of the phthalic alkyd resins made without rosin The lacquer-type maleic resins are usually dissolved in solvents and used with cellulose nitrate in the production of lacquers They improve the adhesion of the cellulose nitrate lacquers and, when included as an ingredient in wood furniture lacquers, impart qualities of depth to the film

Alkyds based on sebacic and other high molecular weight aliphatic polybasic acids are also suitable for use in lacquers, and they offer good protection against rain and weathering

Polyester resins, often of the alkyd type cross linked with an unsaturated product such as styrene when used in laminating plywood, form a protective surface which often serves to bring out the grain of the wood

Phenolic finishes Perhaps the next most commonly used synthetic resin in wood coatings is the phenolic group These have proved very satisfactory for finishes on plywood in aircraft and on other wood constructions Phenolic coatings have remarkable resistance to the passage of moisture, even when the finish is light-weight and thin Probably the most unusual phenolic coatings are those based on the dispersion resins They first gained attention because of their property of drying through the evaporation of the solvent alone, and having very slight penetration into porous surfaces Further testing showed, however, that this coating was highly resistant to the passage of moisture and possessed remarkable exterior durability Enamels based on these resins have shown excellent protection of wood after two years soaking in water

Some of the current formulations in phenolic finishes for wood are cured by low-temperature baking These result in coatings which are chemically resistant, and which will not scrape or chip off Also production costs are reduced because wood coated with this material can be hot-sanded

Polyamides Polyamide resins can be used in lacquers in conjunction with cellulose nitrate, or as a wood sealant with some alcohol-soluble resin which alone is too brittle as a coating In the latter case, use of the polyamide results in a coating that is sufficiently elastic to be free from checking or cracking This coating is excellent for sealing off knots of pine, Douglas fir, and other high-resin content woods However, the price of these polyamides is still too high for them to be considered on a competitive basis with such established wood sealants as shellac

Cellulosic Lacquers and Dopes From the point of view of quick and easy application, both during processing at the factory and refinishing in the field, cellulosic lacquers and dopes are convenient Various interior surfaces can be successfully treated with these materials and the resultant finishes are satisfactory in appearance However, for applications such as aircraft plywood surfacing, the cellulosics do not exhibit sufficient flexibility and resistance to moisture

WHEN Metal Atoms WANDER

Recognition of the Importance of Time as an Element in Metal Working Is Giving Rise to Theories Regarding the Action of Atoms When Subjected to Heat and Pressure New Techniques Are Growing Out of These Theories

By Edwin Laird Cady

IN THE precision investment casting shop of the Haynes Stellite Company, a tool maker carefully positioned a hard steel model in the bottom of a thick-walled steel cylinder He poured low-melting alloy into the top of the cylinder Then he fitted a plunger piece inside the cylinder and on top of the molten metal Five tons of hydraulic pressure were applied to that plunger piece as quickly as the hydraulic ram could be brought down

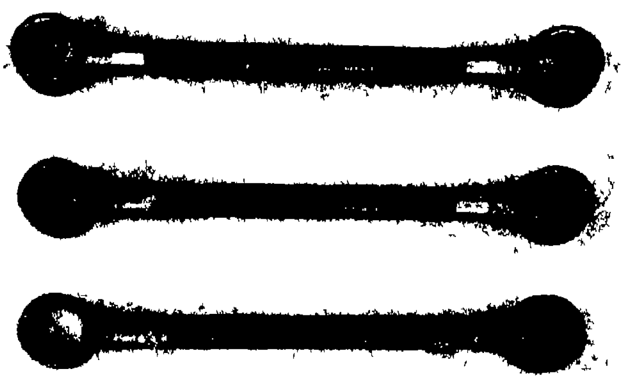
Ask the tool maker what he was doing and he would say he was making a soft-metal mold by the high-pressure casting technique The steel model had intricate contours Under the pressure the low-melting alloy would be forced to conform to the slightest curve, to the smallest hollow in the steel surface The model had a highly polished surface, the mating surfaces of the soft-metal mold would be highly polished also If there were the slightest tool or grinding mark on the model, it would be reproduced on the soft metal surfaces

That the pressure produces fidelities of contours is easy enough to understand Less easily explained is the fact that the pressure has to be maintained for at least 30 minutes

Need to give the molten metal time to solidify would not account for the long time period over which the pressure has to be applied On the contrary, the low-melting alloy is likely to solidify so quickly that the plunger piece has to be heated before use, lest it chill the alloy before the pressure is applied

From such experiences with hot metals, science is evolving a theory which may change the whole picture of the welding industry, and of casting, and of the heat treatments of metals The whole world of metals may be changed Brand new products, new strengths, new methods, may emerge

Courtesy Linde Air Products Company



Tubes and eye castings (above) were compression welded by machine at left

ATOMS MAY SHIFT — Briefly stated, the theory is Given a supply of energy and half a chance, atoms may wander from one metallic crystal to another forming new patterns The accompanying sketch is a schematic diagram of a metal crystal The large round dots represent the atoms which make up the structure

It has long been inferred that under certain changes of temperature or other energy, the atom at position 1 (in the center of the crystal) would move to the face, to a position such as position 2 But, asks the new theory, if atom 1 moves to position 2, why should not the other atoms be in motion also, and why should not atom 1 wander around to positions 3, 4, 5, or 6?

And if two crystals were pushed against each other under heavy pressure and at high enough temperatures, why should not they swap atoms and have their atoms rearrange themselves as if the two crystals were one? If this were to happen, then when the metals and their crystals were cooled to the point where the atoms no longer moved so easily, the crystals would be locked by each other's atoms into a true weld

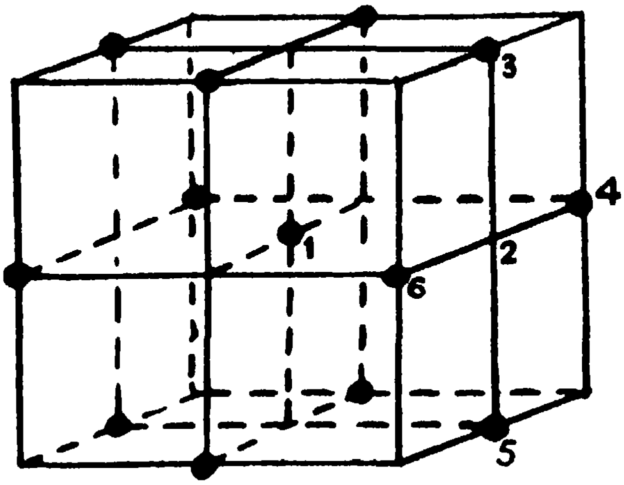
Welding had long been done by fusion methods But at fusion temperature the metals are molten As they cool to the solid state, they form crystals But those crystals are formed together, and are automatically intermingled and interlocked

Cold welding, at temperature below the molten, had been done for thousands of years But nobody understood why the metals joined each other Therefore nobody knew how to improve the process

Here, in the wandering atoms, is an explanation that could be used And an employable hypothesis was all that was needed by the applied science called manufacturing

One of the first starts was in the compression welding of steels Heated to temperatures of 1860 degrees, Fahrenheit, and pushed together by pressures ranging from 1400 to 5000 pounds per square inch, depending upon the compressive strengths and therefore the resistances of the metals to upsetting under compression, the steels would become welded together

Preparing for high-pressure casting of soft metals
Courtesy Haynes Stellite Company



The metal atoms, represented by the black dots, will shift if the energy conditions are right

The welds were not complete enough for a great many purposes Etched and then examined under a microscope, clear weld lines could be seen The atoms had not interchanged enough to merge the crystals fully

Higher temperatures, up to the range of 2192 to 2282 degrees, Fahrenheit, were tried The results were much better when the atoms had this much more energy to work with The weld zones tended to disappear

Engineering long had known that normalizing—holding the steel at a temperature above its critical range—tended to cause crystals to merge What the atoms seemed to need was more time to wander back and forth within their own crystals and to emigrate from crystal to crystal With the added time, they could form their new patterns among the crystals and at the juncture of the crystal faces, do a truer welding job

ATOMS LOCK CRYSTALS — Normalizing was tried The added time was given And the atoms did what was expected of them They locked the crystals together so completely at the weld zone that no difference could be seen between that area and any other in the steel Tensile and other physical strength tests showed that the microscope was telling the truth The weld zone had become exactly like the parent metal

One of the first industrial applications was the flame-compression welding of eye castings to torque tubes for aircraft landing gear This was done by the Linde Air Products Company's process on automatic equipment developed by the Menasco Manufacturing Company The tube and one eye-casting were carefully cleaned, then were abutted A ring of flame was applied to the juncture, and the pressure was applied When at upsetting temperature, the two parts moved together

Castings are difficult to weld to wrought steel or to anything else But this process welded them so completely that there was no known way of testing the weld The shops had to depend upon the examination of chips machined away when machining the upset area down to the diameter wanted in the assembly,

• LOOKING AHEAD •

Castings, ferrous and nonferrous, of greater strengths Perfect welds New knowledge about powder metallurgy Changes in the whole world of metals, wherever heat is applied

and upon destructively testing some of the assemblies

Another application was that of metals which are chemically different The theoretical argument was that if the alloy of the two represented a lower total energy, then either welding should take place or else a special compound would be formed In addition, if the homogeneous mixture were stronger than the mean of the two metals then the weld would be a strong one

The theory was tried out Stainless steel (18-8) was flame-pressure welded to engineering steel NE 9440 The bonding zone was proved to be a distinct alloy of much greater strength than either of the parent metals, and so thin that only an electron microscope could find it When tested physically, the welded piece invariably failed in the stainless steel, which was the weaker of the two parent metals, and invariably at the full strength of the stainless

WITH NONFERROUS METALS — The general idea of applying pressure plus heat plus time was tried with nonferrous metals It worked with silver It worked with copper, and with many of the copper alloys, especially if the copper could be held within a closed chamber which would prevent it from losing too much heat by conduction

The atoms apparently would wander, then, if temperature or some other force gave them energy enough, if pressure brought the faces of the metals close enough together so that wandering was easy, and if enough time was provided Further experiments are showing that, within limits, these three factors are adjustable Nobody knows just how all of that will work out But if the time is extended, then the pressure and temperature can be lower And if the temperature is raised, then the time and pressure can be less

Powder metallurgy is making use of this theory Copper and alloy powders join at thousands of faces when compressed within the molds The pressure, time, and temperature are far more controllable within the molds than when the metals are exposed to the air, as they must be in either flame or electrical compression-butt welding The powder particles are being joined with welds which show every evidence of being complete

Pressure-welding of low-melting alloys to make injection molds is only one of the tasks which are being done in the casting industry Here are all sorts of opportunities The crystals of many metals tend to become large if castings are cooled slowly, as many castings must be But cooled under heavy pressures, so that the crystals are under welding pressures through all of their welding ranges, the castings are tending to develop strengths and homogenieties never before obtained in cast alloys And the pressures are easily applied—by hydraulic force, by centrifugal force, or even by pneumatic lines

Developments of these techniques are mostly in the future One application after another is being tried experimentally The list of commercial successes is slowly growing But nobody can predict what the effect will be upon industry when more of the atoms of metal crystals are encouraged to wander

Welding a high speed core bit to a low carbon shank by the flame pressure method

Courtesy Linde Air Products Company

FUELS OF THE FUTURE:

For Reciprocating Automotive and Aircraft Engines

Editor's Note: **The accompanying article is the first of four, adapted by permission from papers presented at a recent Standard Oil Development Company seminar on Fuels of the Future. Each paper deals with different phases of fuels for engines of types now in use, under development, or projected. Together they summarize the general subject and furnish a glimpse of the fuels and engines which technology will be offering to transportation in the years to come.**

By Albert J. Blackwood
Assistant Director Research Division
Esso Laboratories

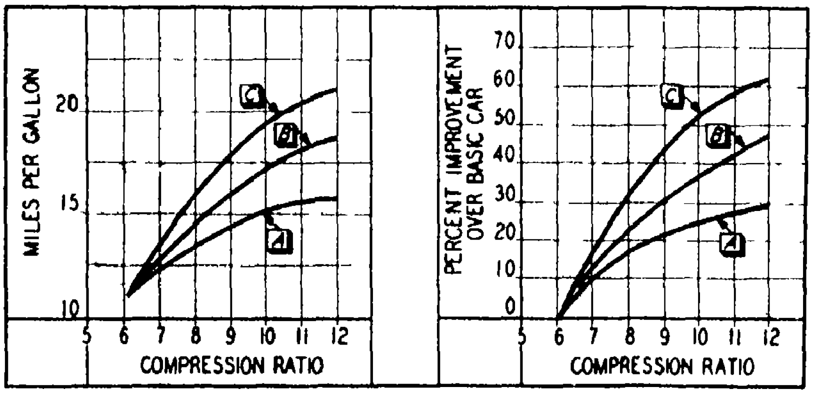
A LITTLE less than ten years ago, the turbo-jet reaction engine was first demonstrated as a practical means of propulsion, and the dominant position for motive power which the reciprocating engine had long enjoyed was seriously challenged.

In spite of the importance of the reaction engine and its many variations and applications, its birth did not signal the death of the reciprocating engine. Reaction engines were admirably suited to the high speeds and high altitudes that aircraft were striving to attain. But no one type of engine is best for all speed and altitude ranges. The reciprocating engine has been the work-horse of the automobile and aircraft so far. And although it may yield to the newer engines for the high-speed and high-altitude aircraft operations of tomorrow, it will long continue to serve as an important automotive as well as aircraft engine.

Much attention these days is being given to reaction engine fuels, but extensive research is also in progress on developing fuels for the improved reciprocating engine of the future.

AUTOMOTIVE FUELS — In the reciprocating automotive gasoline engine under otherwise similar operating conditions combustion efficiency is related to the compression ratio—the measure of how much the fuel-air charge in the cylinders is compressed before being fired. The more the charge is compressed, the higher the combustion efficiency—provided the engine does not knock because of inadequate fuel quality. Thus the knock rating, or octane number, requirement of the fuel is tied in with the compression ratio of the engine.

Discussions of the knock ratings of gasolines may at times be confusing because there are in common use today several different test methods for determining these ratings. The two methods most commonly employed for motor gasoline are referred to as the A S T M Motor Method and the Research Method. The numerical values of octane numbers obtained by the two test methods are rarely identical for a given sample of gasoline because each method focuses on the behavior of the gasoline under specific operating conditions. The Motor Method appears to be better for determining tendency to knock under severe operating conditions, such as in an automobile at high speeds or in an airplane during



Left: Effect of compression ratio on economy at 40 miles an hour. Basic car has a 230 cubic-inch engine. In curve A, is effect obtained by increasing compression ratio; in B, displacement has been reduced in high-compression engine to give same car performance at 50 miles an hour; in C, axle ratio has been reduced, but displacement unchanged, to give same performance at 50 miles an hour. Opposite page: Graphic representation of the value of octane number

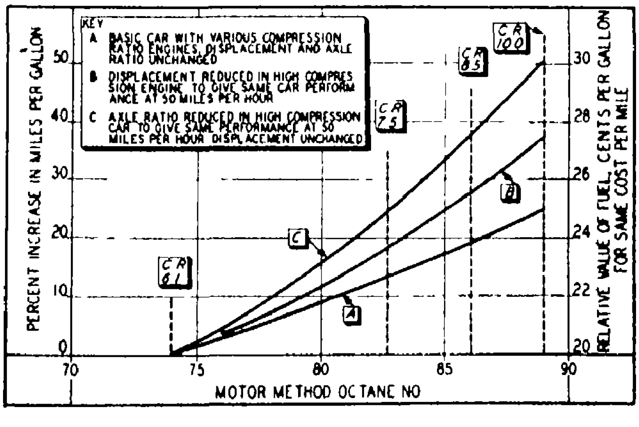
take-off and climb The Research Method is a better indication of knocking tendency under mild conditions of use, such as an automobile in traffic Neither method alone predicts accurately what will actually take place in the engine of an automobile on the highway under all conditions

Automotive engine compression ratios have steadily increased over the years in order to take full advantage of increasing gasoline knock ratings In 1930 compression ratios averaged around 4¾ and Motor Method gasoline knock ratings averaged slightly over 60 (the Research Method was not then in use) At the start of World War II the average compression ratio was about 6½ and the Motor Method knock rating of regular-grade gasoline was 73 while that of premium gasoline was about 80

These increases in knock rating have been accomplished with a decrease in the service-station price of regular-grade gasoline, exclusive of taxes paid there, from about 16¼ cents per gallon to 12¾ cents per gallon At the same time, labor costs were, of course, increasing Raw materials—in this case crude oil—remained at about the same price level The output of more efficient gasolines at lower prices was made possible largely through improved refining processes, in turn the result of research and development work by the petroleum industry At the same time, progress in refining technology has made it possible to produce more gasoline today than before from the same amount of crude

HIGHER COMPRESSION — Gasolines are now being developed and tested for automotive engines of as high as 12 to 1 compression ratio, which require a gasoline of nearly 100 Research octane number Gasoline of this quality level could be made with already known refinery processes Its cost per gallon would be a little higher than current motor gasoline, but the saving in mileage to the motorist would more than compensate for the increased cost Such a gasoline is not yet on the market because engines are not yet generally available that would benefit from it Without changing the performance characteristics built into an engine, an increase in its compression ratio from today's average value of about 6 5 to 1 to 12 to 1 can give as much as 50 percent increase in miles per gallon of gasoline Possible future improvements in fuel economy can be expected from such increased compression ratios together with changes in engine displacement as well as changes in axle ratios

Since knock limits the efficiency that can be derived from a given engine-fuel combination, research on motor gasolines will continue to include studies on the subject of the detonation, generally considered to be a function of the chemical composition of the fuel, although the physical characteristics of the engine may be contributing causes Some aspects of the physical condition of an automobile that can cause engine knock are carbon deposits in the firing chamber, hard-water scale and rust in the cooling system which cause overheating, spark plugs that run too hot, heavy loads carried by the engine, and incorrect air-fuel ratio resulting from an improperly adjusted carburetor Any of these factors, plus too high a compression ratio for a given quality fuel, can cause detonation But, in the final analysis, it is the reaction of these factors on the fuel that results in detonation



OBSTACLES TO HIGH-OCTANE — High-octane aviation gasolines are not entirely suitable for automobile engines because of the different conditions under which they operate However, the technology and new equipment which made possible the production of aviation gasoline are definitely applicable to the manufacture of high-octane motor gasoline All indications have been that, with the return of peace, the trend in motor fuel octane ratings would continue upward as in the years before the war Several factors, however, temporarily have slowed that progress One of these is that for a number of reasons motor-car manufacturers have not introduced new engines of much higher compression ratios than before the war As far as gasoline requirements are concerned, most of the 1946 and 1947 model cars are essentially the same as their 1942 predecessors In addition, metallic lead restrictions were imposed by the Government for several months last year and this year, which prevented petroleum refiners from adding to gasoline the quantities of tetraethyl lead necessary for substantially raising octane numbers

As motor-car production reaches its normal rate and the way becomes clearer for research into new types of engines, the trend will undoubtedly be toward engines of higher compression ratios—perhaps as high as the 12 to 1 ratio already mentioned—but of smaller piston displacement The petroleum industry will be able to supply new and better fuels to satisfy the requirements of these new engines

It is difficult to predict the exact way in which the improved performance of the new gasolines will be utilized in engines of the future There are a number of directions in which progress can take place Motorists may want greatly increased acceleration and speed, and if highways are built to accommodate higher average speeds, new higher-octane fuels can be employed to develop the necessary power while maintaining fuel economy at today's level On the other hand, motorists may want greatly increased economy of operation, in which case they will have to be satisfied with comparatively small increases in the power of their cars Dramatic progress can be made in the direction of more power or greater economy Simultaneous progress in both directions is possible, but in that case it cannot, of course, be so great in either one alone

A number of variables in future automobile design besides compression ratio may effect the fuel quality required Among these are superchargers, hydraulic

Dynamometer and control board for testing performance of gasoline in automobile engines

transmissions, and torque converters Supercharging permits more fuel to be burned for each stroke of the piston and places a premium on knock rating just as increasing compression ratio does Hydraulic transmissions give the equivalent of more frequent gear shifting and, in engines so equipped, the revolutions per minute of the engine during full-throttle operation are generally higher At high engine speeds there is less tendency to knock than at lower speeds, so that hydraulic transmissions may lower anti-knock requirements of the gasoline The hydraulic torque converter is now in use in some buses, and many automobile builders are presently experimenting with the converter for use in passenger cars It is not yet clear exactly what effect torque converters will have on the anti-knock requirements of the engine, but the development of torque converters is being followed closely by the petroleum industry, and fuels suitable for use in cars so equipped will be available

AVIATION FUELS — During the war, high take-off power in aircraft engines was essential to lift maximum loads into the air, and to enable planes to take off on short and undeveloped airfields Cruising fuel economy was also important in order to give airplanes the greatest possible flying range with heavy bomb loads In other words, maximum power from the gasoline consumed was indispensable

In the reciprocating aviation engine, the extra power needs are accomplished by high supercharging, which in turn calls for high octane rating in the gasoline Aviation engines differ from automobile engines in that the fuel-air ratio is varied in the course of operation—a rich fuel-air mixture being used for take-off and a lean fuel-air mixture for cruising Before the war, aviation gasoline was of 100-octane number, assuring good cruising fuel economy However, this rating did not necessarily mean high enough rich-mixture performance for quick take-off and for bursts of power in flight During the war, a new rich-mixture knock-rating method was developed and the rich-mixture rating of aviation gasoline was gradually increased considerably in excess of 100 Thus, by the war's end, 100-octane aviation gasoline was actually better than 100, and was officially known as Grade 100/130 gasoline meaning that it had 100-octane rating for lean mixture and 130 rating for rich mixture The figure used to express ratings of over 100 indicated approximately how much more power could be obtained from the gasoline than from 100-octane-number gasoline

By the end of the war, gasoline even better than 100/130 was available Now Army-Navy specifications are being set at 115/145, and some commercial airlines are expected soon to begin using 115/145 or possibly higher-octane aviation gasoline Fuels of this quality level can be supplied in reasonable quantities

Anti-knock quality is but one of many characteristics of aviation gasoline under continuous investigation Volatility, for example, is also important, and its effect on gasoline performance under reduced barometric pressures encountered at high altitudes is significant Stability and freedom from gum are necessary in an aviation gasoline to insure reliable engine operation And considerations of engine design, such as cylinder-head fuel injection, already installed on some commercial airliners, may influence characteristics required of a fuel

DIESEL FUELS — The high-speed Diesel engine uses a distillate fuel oil whose measure of burning quality is expressed in terms of cetane number, as octane number expresses knock characteristics of gasoline

With increasing use of these engines, there has been a trend toward seeking super fuels of exceptionally high cetane numbers Diesel engines must be of heavy construction to withstand the high pressures devloped with present fuels If super fuels could be found which would not require the high pressures now needed to ignite the fuel, engine weight could be reduced and smoother operation would reduce maintenance and increase engine life One method of achieving such a super fuel would be by the use of ignition promoters, substances that could be added to the fuel in small quantities, as tetraethyl lead is added to gasoline, to effect improved burning quality Although moderately successful ignition promoters have been found, it is still hoped that some superior compound, perhaps a presently obscure chemical, may yet be discovered

The growing commercial application of the Diesel engine may materially affect the nature of the future Diesel fuel Whereas highest grade Diesel fuel has usually been straight-run distillate from paraffin-base crude oil, an excessive future demand for the fuel may make it economically desirable to manufacture it from other sources, incorporating required properties by the use of special additives.

[*Next month Gas Turbine and Jet Propulsion Fuels*]

Soaps In Reverse

Used in Ever-Increasing Volumes, Ammonium Quaternaries with Their Unusual Germ-Dissolving Properties Have Shown Themselves Superior in Many Ways to Conventional Materials in The Disinfecting and "Sanitizing" Fields

By Howard C. E. Johnson, Ph D
Chemical Editor, CHEMICAL INDUSTRIES

YOU CAN wash your hands, sterilize food-handling equipment, and improve textile finishes with quaternary ammonium compounds Chemically the opposite of soaps, they can do many of the things that soaps can do—and do some of them much better Unknown except in the laboratory until a few years ago, quaternary ammonium compounds have caught on to the extent that production of them jumped from 850,000 pounds in 1943 to almost 3,000,000 pounds in 1945 The 1945 figure is the latest one available, but production last year and this year is undoubtedly still greater

When one considers that these compounds sell for over $1 a pound, far more than other disinfectants, their phenomenal acceptance is truly surprising The explanation because they are non-irritating, non-corrosive, and non-poisorous, the quaternary compounds can be used where chlorine or phenols cannot Their high germ-killing power, moreover, enables them to be used in much higher dilution and makes their apparent high cost pretty much of a mirage

These quaternary ammonium compounds are salts —not of a metal, as is sodium chloride or calcium sulfate—but of a nitrogen atom In the usual ammonium compounds—like the ammonium nitrate that blew up Texas City last April—the nitrogen atom is surrounded by four hydrogen atoms The "quaternary" in this case means that all four of the hydrogens have been replaced by organic, carbon-containing groups The terms primary, secondary, and tertiary are likewise used to indicate substitution of one, two, and three hydrogen atoms, respectively, by such groups

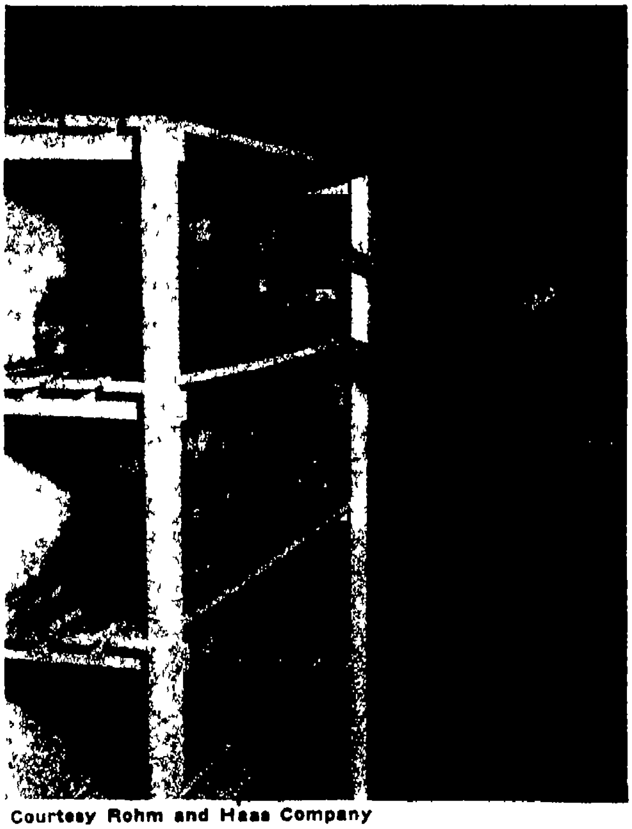
All salts consist of two portions which are held together by virtue of the fact that one portion, called the cation, bears a positive electrical charge, and the other portion, called the anion, is charged negatively In ammonium nitrate, mentioned above, ammonium is the cation and nitrate the anion In the quaternaries, one of the groups attached to the nitrogen atom in the ammonium cation is a paraffin-like water-insoluble group which confers soap-like properties upon the compounds Because this group is found in the positively charged portion of the molecule, quaternary ammonium compounds are often called cation-active materials

Soap and the better-known synthetic detergents like Dreft and Vel also contain a paraffin-like, water-insoluble group But in this case it appears in the anion Thus, while soap and the quaternaries have a lot in common, property-wise, they are actually opposite numbers, chemically speaking

SINCE 1908 — References to quaternary ammonium compounds appeared sporadically in scientific literature from 1908 on From the first, it was recognized that these materials were potent weapons against bacteria, and in 1916, two scientists at Rockefeller Institute described over 200 of these compounds in a series of eight publications

Twenty years went by, and industry paid no attention Then, in 1935, Gerhardt Domagk, the German scientist who had discovered sulfa drugs a few years

Humidity room where various quaternaries are tested as slime preventives



Courtesy Rohm and Haas Company

before, called attention to the high anti-bacterial activity of a simpler type of quaternary than had been studied previously.

A great deal of research, both in this country and abroad, followed Domagk's announcement, and even before the war, the value of these materials in antisepsis and disinfection was firmly established.

THEY ARE LIKE SOAP — Some of the quaternaries will wash hands, shampoo the hair, launder woolens, and clean dirty eggs in much the same way as soap. One manufacturer, the Emulsol Corporation reports that its product, called Emulsept, is being used in an impregnated paper for washing the hands of physicians and dentists. It is also being used in food processing plants for washing fruits and vegetables as they are received from the farm.

Quaternaries are being employed more and more in restaurants and soda fountains, fisheries and poultry farms, dairies and pasteurizing plants, bakeries and cold-storage warehouses, hospitals and doctors' offices.

AND NOT LIKE SOAP — If cleansing were the only object, there would be no economic justification for using high-priced quaternaries instead of low-cost soaps or synthetic detergents. But these relatively costly and complex chemicals are being used increasingly in restaurants, hospitals, and other places where disease-carrying germs lurk. They are used here not because they are soap substitutes but because they are powerful germicides.

• LOOKING AHEAD •

Public health promoted by more effective sanitation of food-handling equipment

Expanded use of non-corrosive, non-irritating, non-poisonous disinfectants

Same chemicals applied in increasing quantities to fabrics, giving permanent waterproofness, softer finishes, and greater fastness to dyes

Carbolic acid (phenol) is the long-established disinfectant against which other materials are rated. One of the new quaternaries, Emcol 888, is 600 times more effective than phenol against the organism which causes typhoid fever. The quaternaries, moreover, are effective in concentrations as low as one part in 50,000. Early applications of the quaternary germicides were in surgical procedures, where they were used not only to cleanse and sterilize the operative site for surgery, but also in scrubbing the surgeon's hands and arms to destroy organisms.

Many of the quaternary compounds are odorless, colorless, non-irritating, and non-toxic in germicidal

Courtesy Rohm and Haas Company

Left:
Odorless, non toxic, fast acting ammonium quaternaries provide highly effective germicides for dish water

Right:
Medical instruments can be sterilized without heating by means of the potent quaternary ammonium compounds

concentrations and of course, they contain no phenol, iodine, mercury, other heavy metals, or free chlorine Solutions are stable in storage, they are not volatile nor are they affected by boiling Because of these unusual virtues, they can be safely used on food utensils, dairy equipment, operators' hands, and even on food itself Phenols, cresols, pine-oils, mercurials germicidal dyes and other odoriferous and relatively toxic germicides are barred from such applications

FAST ACTING — The quaternaries offer advantages too, over chlorine or hypochlorites as disinfecting or "sanitizing" agents Chlorine gas and water containing large amounts of free chlorine are irritating and corrosive In eating and drinking establishments alkaline hypochlorites and chloramines usually act too slowly to be effective when glasses and dishes are rinsed rapidly Solutions must be renewed frequently, for the active hypochlorite deteriorates rapidly and is inactivated by the organic matter rinsed off the dishes

Extensive field tests reveal that the quaternaries are as effective as—or even slightly more active than—chlorine in reducing the bacterial counts on used glasses The potency of the quaternaries does not fall off during use moreover, and their activity is not affected by impurities in the water

The quaternaries have also been used successfully in the disinfection of wounds and deep lacerations, in wet dressings and irrigations and in the treatment of skin lesions caused by fungi Properly used they are highly active in "cold sterilization" of medical and dental instruments

Public health authorities, too accept quaternaries as suitable substitutes for chlorine disinfectants and employ them for control of mastitis, streptococcus staphylococcus, colitis, diphtheria and other bacterial infections in cattle

"DISSOLVES" GERMS — By a mechanism not yet well understood, the quaternaries attack bacteria in a manner unlike any other germicide They seem actually to dissolve the micro-organisms

Bacteria, just like human beings contain organic nitrogen and phosphorus compounds These compounds are normally retained within the cells, but in the presence of germicidal concentrations of quaternaries the nitrogen and phosphorus are released

The quaternaries are apparently adsorbed on the surface of the bacteria where they have an injurious effect on the cell wall The membrane is irreparably ruptured, and the germ simply falls apart

WITH FABRICS — Although it is as germicides that the quaternaries are most spectacular it was in an entirely different capacity that they found their first commercial application About 1930 it was discovered that quaternaries improve the fastness of dyed fabrics to water They probably react with the dye molecules to form water-insoluble compounds without affecting the colors of the dyes

Then a few years later it was found that the quaternaries were adsorbed onto cellulose from very dilute solutions and that fabrics could thus be rendered very soft and smooth Literally millions of miles of fabrics have been processed with the so-called "cationic finishing agents" or "cation-active softeners" The effect imparted by these materials persists even after repeated washings which is rather surprising in view of the fact that the quaternaries are water-soluble

A still newer process using quaternaries makes fabrics waterproof Older waterproofing methods simply consisted of applying a paraffinic coating to the fabric This was not permanent, however for the coating would come off during wear or upon the application of dry-cleaning solvents In the new process of which Du Pont's Zelan is an example, the paraffin-like group is part of a quaternary ammonium compound The quaternary is applied in water solution to the fabric, which is then dried and heated At high temperatures the quaternary decomposes and the paraffin-like group reacts with the cellulose of the cotton or rayon, giving a permanent waterproof finish to the textile

In spite of their relatively high cost, the quaternaries are here to stay Public health authorities—be they local state, or federal—are aware of the danger of disease transmission by unsanitary dairies restaurants and soda fountains Charles McDonald director of the Dairy and Food Division of the Akron Ohio, Health Department conducts a continuing educational campaign among food handling personnel, he reports that over 70 percent of Akron restaurants use synthetics for washing dishes

The field of antisepsis is a huge market in itself Add to this the various textile uses, and it becomes obvious that quaternaries are going places

Metals Through the Microscope

Editor's Note: The accompanying article is the first of a series dealing with industrial applications of photography in all its phases These articles will be designed to show our readers how the principles of photography can be utilized in a wide variety of industries and in locations ranging from the research laboratory, to the training school, and to the production line. Queries are invited from interested readers and suggestions for future articles in the series will be welcomed

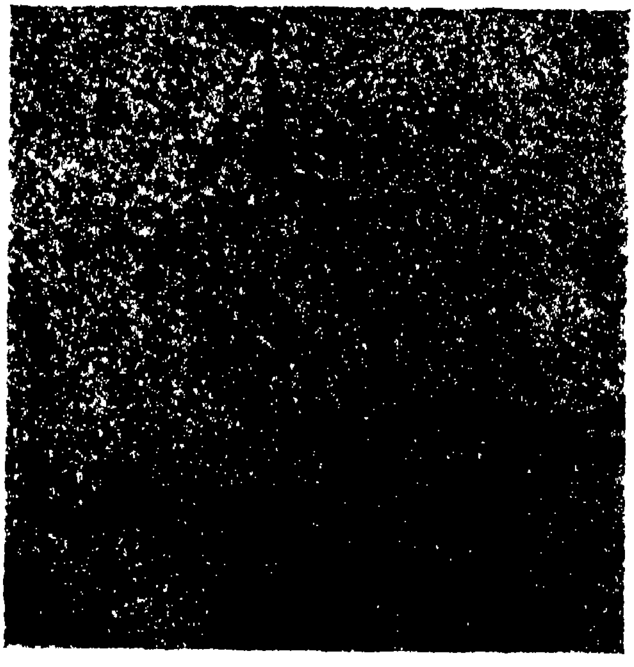
Photography of Prepared Specimens Provides Permanent Records of Metallic Structures For Future Reference Technique Can be Applied to Quality Control as Well as to the Search for New Alloys and New Treatments Equipment for Photomicrography of Metals Has Many Other Uses

By Peter R. Lewis

Photographic Service Technician, New York Sales Branch
Ansco Division, General Aniline and Film Corporation

MICROMETALLOGRAPHY is to the metallurgist what microscopy is to the doctor in the field of medicine It deals with the anatomy of metals and shows exactly how changes in metal structure can influence the course of mechanical and thermal treatments to which they will later be subjected In like manner, it can reveal the changes which take place within metals themselves after they have been worked, tempered, welded, or heat treated

One example of the many possible industrial uses of photomicrography is this micrograph, taken at a magnification of 500X, which reveals the structure of the alloy obtained by the brazing of two pieces of copper



The microscope furnishes the means by which the metallurgist can determine good, poor, or indifferent physical properties of metallic structures, coupled with the camera it provides essential and permanent records for future study and comparison

Some of the phases of metals that can be studied and photographed by means of micrometallographic equipment include internal stresses due to fatigue, as revealed by intergranular structure, fractures and discontinuities from various causes, non-metallic inclusions, and identification of unknown metals by comparison of photomicrographs

In addition, the same equipment used for photomicrography of metals has a number of other applications in industry It can be used to study small-particled substances such as paints, fillers for plastics, and other non-transparent materials in the course of research or of production quality control Likewise, soap, oils, fats, waxes, and the like yield many of their secrets to the probing eye of the microscope In fact, there is hardly a single aspect of industrial research or production that cannot make profitable use of data revealed on the photographic negative as exposed through the lens of the microscope

During the past few years there has been a marked increase in the use of photomicrographic systems to study and make permanent records of metallurgical specimens With the increased use of innumerable metal alloys and the large-scale research being conducted by industry to find new substitutes for depleted metal stocks, there has been a need for maintaining records of new metals being manufactured—records which show the progress of research and then follow the metals through their final fusion and their rigorous uses during tests

The metallurgist in his work must be able to produce metals which are required to meet exacting specifications set down by the industrial field To keep records of a metal as it is developed to meet these specifications, the photomicrographic method provides an illustrated progress report to which the metallurgist can refer any time

REFLECTED LIGHT USED — One of the basic principles involved in using a camera in a metallurgical photomicroscopic system is that the light utilized is reflected light rather than the transmitted light employed in a microscopic system used for examining biological or medical specimens In these latter fields, samples are very thin in order that a maximum amount of light can be passed through the specimen and recorded on the sensitized material used in the camera For metallurgical work, however, the sample under study is opaque, this is the factor which makes it necessary to utilize reflected light to record details on the photographic film

In order to obtain proper exposure of the negative in the camera, it is necessary that the light source be intense, since a great deal of light is lost when reflected from the opaque surface Metal, unlike most living cell specimens, can fortunately withstand a considerable amount of heat from the high illumination which must be used for this form of photomicrography

To modify a simple microscopic system in such a way that it can be used for metallurgical study, several changes must be made These changes involve removing the objective, the stage, and the condenser used in a standard biological microscope and replacing them with a new stage and a short-mount objective A direct illuminator is used in place of the condenser

The new stage is solid, it does away with the center hole type used for biological work The short-mount objective permits studies at high magnifications to be made of thick specimens and can be considered analagous to the use of the telephoto lens in ordinary photography

The metallographic setup shown in one of the photographs is one of the simpler types which are available There has been a marked trend in recent years toward the inverted type of microscope for this work, because of its sturdiness However, this type is very expensive and is employed primarily by industries which require continuous use of photomicrographic apparatus in metallurgy

CRISP IMAGES — Because of the basic principle of the metallurgical microscope the specimen can be studied not only in ordinary reflected light but it can also be viewed and photographed under polarized and ultra-violet light as well Use of these light sources, selected according to the desired results, provides a high resolving power with which it is possible to obtain crisp, brilliant images of very small particles In addition, the stage used in the metallurgical microscope system may have provisions for measuring very accurately the faces and angles of the crystals of a specimen placed on it This feature is an important one in identification of metallurgical materials

The greatest difficulty in using the microscope in the field of metallurgy is the preparation of the sample The thickness of the sample does not matter but the surface of it must be carefully ground and polished to mirror brilliancy In fact, the same care must be exercised in polishing these metal samples as in polishing precious stones, and most of the tools used are actually lapidary instruments

When the modification of the microscope and the preparation of the sample has been completed, normal methods of microscopic manipulation and photographic exposure can be used to supply the metallurgist with an accurate record of any particular metal he may wish to study

Above: Photomicrographic apparatus using transmitted light. The stage has a center hole. Below: The same equipment adapted for metallurgical study with reflected light. Note prepared sample on solid stage

SCIENTIFIC AMERICAN'S
Industrial Digest

REMODELED DRAFTING ROOM

Lowers Strain on Workers Through Better Lighting, Air Conditioning

MORE THAN 150 designing engineers in a recently enlarged drafting room have found that the room's new lighting and air-conditioning materially reduce the strain of their work.

Recessed, fluorescent units on 3-foot centers, extending the length of the room between welded rigid frame arches, have each been equipped with one daylight and one soft-white 40 watt tube. With mounting heights which range from 13 feet near the outside of the 70-foot span to 22 feet at the peak, a uniform, well-balanced lighting intensity of over 90 foot-candles is maintained on the drafting tables. The troffer units have been suspended from the purlins, and the metal acoustic ceiling is supported by these lighting fixtures.

Three lines of air-conditioning supply ducts are located on each side of the room toward the outside of the span. These extend the length of the building, and are supported on the rigid frame arches being located between the purlins. A space between the four lines of purlins in the high center section serves as a return air duct.

Air-conditioning machinery housed in a small two-story equipment building adjoining this drafting room of the Austin Company, includes a fan room designed to handle 35,000 cubic feet per minute. A new type of electrostatic filter, which applies an electrical charge of between 6000 and 9000 volts to filter paper, has been installed on the second floor. Reciprocating refrigerating compressors of 100-ton total capacity have been installed on the first floor, with evaporative condensers and other auxiliary equipment. Steam for heating is supplied by the existing boiler plant.

Recessed fluorescents maintain a light intensity of 90 foot-candles on the tables

POLYMERIZED PAINT BASE

Results in Longer Lasting, Better Looking Coats

HOUSE PAINT, superior to pre-war grades in appearance, dirt resistance, and durability is the result of war-time technical development of meet the critical shortage of materials. The new paint, in which polymerized oils are used, has greater pigment content that the pre-war paint, and has more flow. This combination means higher gloss and a smoother finish with fewer brush marks and streaks. It is also much faster drying making for a shorter period of time during which wet paint can pick up dirt and moisture. When fully dried, the paint stays cleaner, since there are no sharp brush marks to catch dirt. And after the paint has been well exposed, it undergoes a self-cleaning chalking process which shows a marked improvement in appearance over the older types of paint.

The greater durability of the new finish results from the high pigment-content and a binder made up of polymerized and raw linseed oil. Developed by the Sherwin-Williams Company, the new binder in which much of the oil has already been processed to a comparatively high state of polymerization, leaves a film that dries more thoroughly than the old, preventing runs, sags, and wrinkles, and providing a harder finish with considerable resistance to scratching and gouging.

The durability of the new paint is also increased by the fact that the few and shallow brush marks result in a thicker average film than the more deeply-marked pre-war paint.

CELLULOSE DERIVATIVE

Forms Many Useful Films, Improves Detergents

A WATER-soluble derivative of cellulose, carboxymethyl cellulose, which shows great promise as a thickening agent, a constituent in cosmetics, and in a score of other uses, is now being manufactured in this country.

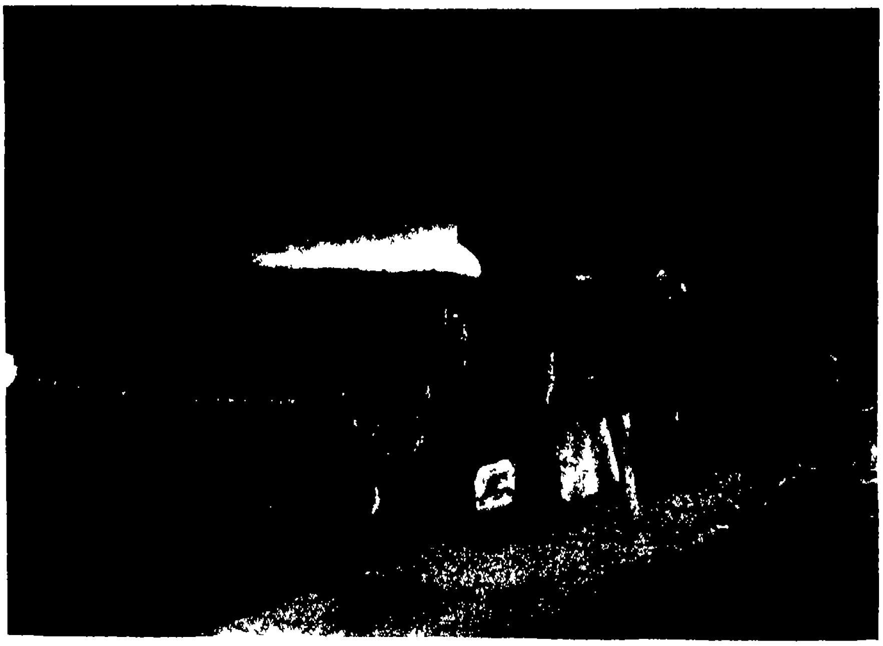
CMC, as the material is called for short is like soap in one respect—that it is the sodium salt of a weak water-insoluble acid—and, as with soap a precipitate is formed by the addition of acids or heavy metal salts to its solutions. Films of CMC are insoluble in all of the common organic solvents, such as acetone benzene, ether, carbon tetrachloride, mineral oil, or peanut oil.

As a thickening agent, the material may be used in textile printing pastes, latex dispersions, embalming fluids, and other applications where viscosity regulation is important. CMC is useful as a stabilizer for emulsions and suspensions such as lotions, creams, and tooth pastes. In emulsion paints and lacquers, its film-forming properties come into play as they also do in grease-proofing paperboard and sizing paper and textiles. This new product is also applicable as a binder and vehicle in crayons and leather pasting, and its colloid properties give it important stature in latex creaming, ceramic glazing, can-sealing compounds, and insecticide formulations. Of vast potential importance is its use in conjunction with synthetic detergents. Large amounts were used in Germany to improve the action of detergents in the laundry.

The material is now being produced by Hercules Powder Company, Dow Chemical Company, Standard Chemical Company Ltd., and Sylvania Division of American Viscose Corporation.

Courtesy Hercules Powder Company
Carboxymethyl cellulose

CMC is now selling for 70 to 80 cents per pound. Considering the fact that ethyl cellulose, cellulose acetate and cellulose nitrate, which originally sold for $1.50, $1.00, and $1.00, respectively, are now down to 50, 35, and 70 cents, it is to be expected that CMC will also come down in price over a period of years.—*H C E J*


Removing the last head from the cooled giant casting

CARGO BIN LINING

Meets Plane Needs For Light-Weight Installation

AIRCRAFT companies are using increasing amounts of plastics materials particularly on the interior finish and decoration of their planes. And they have been most progressive in adopting and adapting new plastics to their needs. A case in point is the use being made in United Air Line's cargo ship, the Cargoliner 230 of an ivory-colored plastics laminate Plyon. The material used as interior cargo space lining is a polyester resin-impregnated, glass-fiber cloth.

Plyon was selected not only because of its light-weight flexibility and strength, but also because it comes in panelled sections that are easy to install. Further since the plastics can be cleaned by sponging with water food cargoes can be shipped in the Plyon-lined compartments.

Sheets of laminate 0.0625 inch thick are used for heights of 64 inches. Above that height and extending up over the roof the sheets are 0.030 inch thick. The material is held in place by aluminum cover strips.—*C A B*

GIANT STEEL CASTING

For Forging Press Frame Took Two Months To Cool

RECENTLY completed by the United Engineering and Foundry Company is what is reputedly the world's largest steel machinery casting. It weighs 472,000 pounds and is to be used as a frame for a 6000-ton capacity, high-speed, mechanical forging press.

Four open-hearth furnaces poured molten steel simultaneously into four ladles, which in turn were carried to the pit by overhead cranes. The 600,000-pound main pouring was accomplished in four and one third minutes, after which 100,000 pounds of additional molten metal was poured at several intervals to make up for shrinkage. The casting was allowed to cool in sand for two months. *F P P*

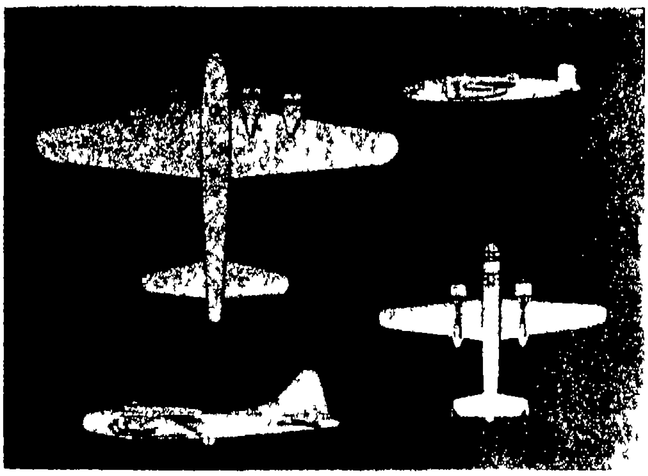
GRINDING'S IMPORTANCE

Increases as Knowledge of Techniques Broadens

PREDICTIONS that the first peacetime year would find a market glutted with precision grinding equipment are being belied as shop after shop spends tens of thousands of dollars to modernize its grinding rooms.

Back of all this is new knowledge that grinding, when carried on with too much cutting force or at too high temperature, can set up work strains in the ground surface and result in quick failures of parts, that much modern grinding has to be carried on with diamond wheels or others so high in cost that only the very latest machines can serve as their mountings, and that grinding must control the type of surface as well as the accuracy.

Only recently has industry realized that, given the same dimensional accuracy, one type of ground surface will shot peen better than another, or will be better for lubricating, for cyaniding, for corrosion resistance. Grinding once was done to dimensional accuracies, now it is done to standards of finishes also, and these



Air Materiel Command Photo

Static collects at indicated points, interferes with radio

Static dischargers eliminate much radio background noise

standards are as yet very little developed and defined In these standards, however, are new horizons for grinding which make its former limitations seem tiny —*E L C*

AIRCRAFT RADIO STATIC

Effects Eliminated by War-Developed Devices

Commercial pilots are now able to get help in bad weather from the same simple static dischargers and suppressors which aided Army pilots during World War II These devices are a series of insulators and strips of conducting cotton wicking so arranged as to provide a protective shield around the entire airplane and to carry off accumulating static, reducing the noise level in aircraft radio communication

An aircraft in flight constantly comes in contact with particles of dust, sand, smoke, ice crystals, snow crystals, and rain which generate charges of static electricity when they strike against the surface of the plane When the amount of electricity accumulated by the plane becomes greater than the amount of electricity in the surrounding air, precipitation static is set up in the aircraft radio receiving equipment

To counteract the resulting sound of "frying eggs" which interferes with aircraft radio reception during the time when it is needed most, Air Materiel Command laboratories at Wright Field developed an antenna insulation system which protects aircraft radio from stray pulses which interfere with radio signals The wick dischargers were developed with the co-operation of the Naval Research Laboratories

This equipment, manufactured by Dayton Aircraft Products under government contract, shields all antenna terminals and splices, permitting good radio reception despite increasing accumulation of static charges on the skin of the plane The wicks provide a means of quietly discharging the static electricity acquired by a plane in flight, and permit clear reception of radio signals

Recent release from government restrictions make it possible for commercial airlines to install these same devices in non-military planes, and commercial pilots will now be able to receive radio signals clearly under nearly all weather conditions

STEEL CONSERVATION

Takes Many Forms In Face Of Low Production

Purchasing agents cast uneasy eyes at the comparisons between our 90,000,000 tons of steel mill capacity and the amount of steel which 55,000,000 employed people will consume Seeing that we cannot make enough steel, ways are sought to get products made in spite of the shortage

Better control of scale is one answer Old fashioned steel mill methods of heating and descaling can waste 10 percent of the steel right in the mills, and another 10 to 20 percent in the heat treating and pickling rooms of the fabricating plants

More strength with less weight in products by better design, more accurate machining, and better heat treating is another steel saver This can mean a boom in the machine-tool market, especially for the most modern machine tools

Alloy steels, even those with slight amounts of alloying elements, can make surprising increases of strength for weight and so get more consumer goods out of the same steel tonnage

Every possible substitute for steel is being considered In former times, the aluminums, magnesiums, plastics, and processed woods, had to fight against steel which was right at hand Now to a large extent they have only to move into fields which steel has abandoned because of short supplies

Foundry methods are under study as never before More than one metallurgist is finding that with close control his foundry can run on scrap which he formerly sold back to the steel mills, and thus eke out his dwindling steel supply The fact that this still further hampers the steel mills, and that more than one steel mill is refusing to ship steel unless it can first get scrap, does not completely prevent the practice of "self preservation" by the large plant that owns a foundry

This situation is likely to go on for some time since the building of new steel plants capable of making up the shortage is unthinkable under present tax and labor laws —*E L C*

CONTINUOUS STILL

For Turpentine, Is Cheaper To Build and Operate

For the distillation of turpentine from the oleoresin of pine trees, a continuous still has shown efficiency and economy of both labor and steam in pilot plant runs made in competition with conventional batch stills Furthermore, the rosin produced by the new still is reported to be about half a grade better than that produced from the same gum by the traditional batch method. The new still operates on the flash principle, the clean filtered gum being pre-heated and sprayed into the flash chamber Here about 80 percent of the turpentine is volatilized to go to the condenser The gum containing the remainder of the turpentine passes down a stripping column counter current to a flow of steam which strips out the remainder of the volatile solvent The new stills are expected to be cheaper to build and install than the present batch stills, as well as cheaper and more efficient to operate —*D H K*

ELECTRONIC BOMBARDMENT

Cleans Optical Surfaces in Preparation For Coat

Cleaning optical glass surfaces by electronic bombardment prior to coating is a process designed primarily for aiding in the application of aluminum, the reflecting agent to television and other first-surface precision mirrors

Blowing the surface dust from a precision mirror prior to lowering the vacuum bell for electronic bombardment

The ground and polished optical glass is placed in a metal holder in a high vacuum bell, where a tungsten filament, similar to the filament in an ordinary electric light bulb, is electrically heated to a temperature at which electrons are "boiled out." Since electrons are negative particles, they are attracted by the holder which is at high-plus voltage with respect to the filament Thus attracted, the electrons bombard the glass at a speed of several thousand miles per second, leaving the surface entirely free of water and extraneous material

After cleaning, the glass, still contained in the high vacuum chamber, is coated with aluminum by an evaporation process The result A mirror of extremely high precision

When the glass is placed in the vacuum bell, an unnoticeable residue of moisture several molecules thick, which is always present on any surface, remains This can be removed only by applying heat, but aluminum will not adhere to a heated surface, hence the electronic bombardment method was developed to overcome that difficulty

Unlike other heating methods, the electronic bombardment technique, developed by the Bausch and Lomb Optical Company, heats only the surface of the mirror, which almost instantaneously cools to the temperature of the remainder of the glass The aluminum coating, applied after this treatment, will adhere

HOT-COLD PIPE

Separates Elements of Heat and Cold in Gases

A piece of pipe 15 inches in length, that blows hot air out one end and cold air out the other requires only a stream of compressed air for its operation—no heating or cooling equipment whatever And in so doing, it achives a long cherished dream of physicists Separation of the elements of heat and cold that are present in every gas While it is barred from the fields of commercial refrigeration and heating, because of its low efficiency, the "hot-cold pipe" may reveal hitherto unknown facts about the behavior of hot and cold gases The instrument also holds good promise as a useful laboratory tool since it is the simplest most inexpensive way of producing low temperatures now known The "hot-cold pipe," as constructed by the Westinghouse Electric Corporation, is 15 inches long and one inch in diameter, and is designed along the lines of a model 18½ inches long but only three-tenths of an inch in diameter, constructed by a German scientist and recently brought to America

Operation of the pipe is amazingly simple Compressed air is pumped into a nozzle at the right end of the pipe Striking a steep spiral there, it is converted into a whirlpool of rapidly spinning gases The air in the center of the whirlpool becomes cold almost instantly while that toward the outside grows correspondingly hotter The inside or cold air then is drawn off through a quarter-inch opening at the right end of the pipe while the warm air goes out a similar opening at the opposite end There are no moving parts and the pipe can be constructed using only a few dollars worth of material

In the original tube, its German inventor, R Hilsch, claims to have produced one air jet as hot as 154 degrees Fahrenheit, and another as cold as 10 degrees, Fahrenheit He also predicted that with proper design of the pipe and control of the air flow, temperatures, more than double the boiling point of water on the one hand, and 50 degrees below zero on the other, can be obtained

The Westinghouse version of the pipe, constructed by Mr Gaylord W Penny, is more than twice as large in diameter as the German original,

Courtesy Westinghouse Electric Corporation

Warm air is drawn from the left end of the pipe, cold air from the right

so that the behavior of air in the "whirlpool" can be studied more easily The larger diameter limits opposite-end temperature differences to only four degrees, but allows measuring instruments to be placed inside the pipe

"What actually happens inside the whirlpool of air is not known definitely at this stage of the research," Mr Penney says "One theory is that the various 'layers' of whirling gas are traveling at different speeds At the center they may be virtually at rest, while a fraction of an inch away they may have attained their highest velocity This speed falls away gradually toward the outer edge of the whirlpool

"Gases traveling at higher speeds are believed to exert a frictional effect on those of lower velocity—much as two surfaces rubbing against one another produce friction—thus transmitting energy from the inner portion of the 'whirlpool' to the gases at its outer edge The net effect is that the outer layers are considerably warmed, while the inside layers are correspondingly cooled No energy, however, actually is gained or lost Whatever heat is extracted to produce the cold stream of air must be added to the warmer end of the flow"

PLATING BATH ECONOMY

Promoted by the Use of Plastics Tubes Floating on Surface

Tubes extruded of polystyrene, cut in three-inch lengths and closed at each end to resemble miniature pillows, when floated on chrome plating solutions in sufficient depth to blanket the bath, protect workmen from the acid fumes and prevent loss of chromic acid in spray form through the ventilating system Heat and electric power in the plating room also are said to be saved by cutting down on the quantity of air withdrawn by the blower

Known as Chrome-Lock tubes, these little plastics "pillows" move apart easily when a rack of objects to be plated is lowered into the solution, and move back into place around the rack spine completely covering the acid bath, while the plating is accomplished

Made of the Dow Chemical Company's Styron, these tubes are resistant to acids, light in weight, and have a smooth texture The tubes, produced by the Udylite Corporation, are not changed in appearance, size, weight, or chemical composition, even when immersed in the extremely strong acid solution for days The plastics is shatter proof, preventing loss of the tubes by breakage, and very few are lost by drag-out when plated objects are taken from the bath

X-RAY INSPECTION

Of Metal Parts Requires A Well-Trained Operator

Inspection of industrial products always has two purposes The first is to prevent shipping imperfect goods The second is to improve production techniques by slowly and steadily compiling statistics about what faults are being produced Thus inspection requires high orders of conscientious attention and imaginative interpretations

Continuous X-ray inspection is a fairly new technique It finds the flaws inside of metal parts without injuring the parts in any way But so much can be told and interpreted by skilled reading of X-ray films that as a rule, the reading task is assigned to a highly trained engineer —*E L C*

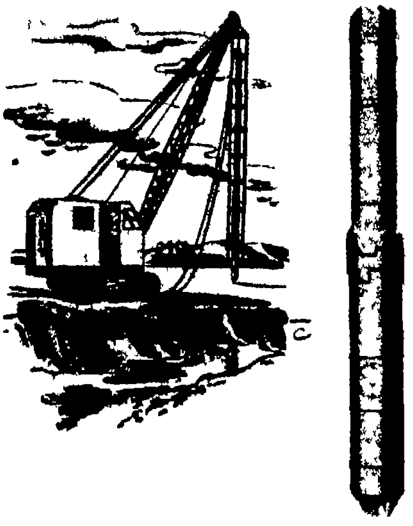
Hidden flaws revealed by X-ray

SOIL COMPACTOR

Operates by Water Jet and High-Speed Vibration

Compacting sandy soil to increase its load-bearing capacity before starting construction work, a vertical cylindrical vibrator is powered by a motor especially designed by the General Electric Company to operate within the vibrator while it is submerged in wet sand

The huge machine, which is handled by a crane, compacts the soil by the combined action of a jet of water and high-speed vibration induced by the motor Called vibroflotation, this method diminishes the volume and permeability of soils, lessens the active soil pressure, and increases the passive soil resistance



Increases soil's load bearing capacity

The entire process, including pumping the water raising and lowering the machine, and driving the vibrator motor, is accomplished electrically Vibroflotation was introduced in this country by Merritt, Chapman, and Scott, contractors, and Parsons, Brinkerhoff, Logan, and McDonald consulting engineers

RADIO YARDSTICK

Measures Distances With High Accuracy

Used by surveyors in measuring distance and position, a new radio system is capable of detecting a one-inch movement of a small radio transmitter It is also capable of measuring longer distances, and is not limited to line-of-sight measurements In this system, known as Raydist, errors can result only from variations in frequency of a single transmitter and from radio propagation phenomena By the use of a high-quality quartz-crystal-controlled transmitter, accuracy of the device, produced by Hastings Instrument Company, is limited only by the consistency of radio propagation —*K H*

NYLON CONSTITUENT

Made From Farm Wastes Or Natural Gas

Tetrahydrofurane, a chemical solvent obtained by a series of reactions starting with oat hulls, corn cobs, and other agricultural by-products, is the basis of a new process for making hexamethylene diamine, one of the two constituents of nylon E I du Pont de Nemours and Company is constructing a $3,000,000 plant at Niagara Falls, New York, to make this intermediate Celanese Corporation is also making tetrahydrofurane from natural gas at Bishop Texas

The interest in this compound is easily understood, for tetrahydrofurane is extremely versatile in its properties It is reported to be an excellent solvent for natural and synthetic rubbers, the difficultly-soluble polyvinyl chlorides, and other vinyl polymers and copolymers It will dissolve large amounts of resins it is claimed, without becoming viscous

Sheer hose from corn cobs or gas

It is also capable of polymerizing giving soft resins or solid rubbers as desired Its chemical reactivity as an intermediate however is its strong asset Formation of the nylon intermediate is only one of such uses its reactions with ammonia amines and sulfides are also being explored as commercial possibilities —*H C E J*

PLASTICS-LINED PIPE

Decreases Corrosion Failures In Oil Well Drilling

To prevent corrosion in the steel pipe used for drilling oil wells, the Spang-Chalfant Division of the National Supply Company has developed a thermosetting plastics coating for the inside of these pipes [First announcement on page 112 March 1947 Scientific American — *Editor*]

The problem in developing this coating was to find a material that could withstand the operating conditions in oil well drilling, and that could be applied to 30 foot lengths of pipe The coating had to be impervious to oil and water, be resistant to chemical attack be able to withstand temperatures as high as 400 degrees, Fahrenheit, and to stand abrasion without flaking off

To apply the coating, the 4¼ inch pipe is first shot-blasted on the inside Then the thermosetting liquid is forced up inside the pipe until it reaches the top It is next drained down slowly so that no air bells or streaks are formed After a normal-temperature short drying time, the pipe is placed in an oven and the coating baked This process is repeated for four coatings — *C A B*

CASTING INSPECTION

Greatly Simplified By Three Dimensional Projection

Having seen several years of successful application to thousands of intricate ferrous and nonferrous castings a method for inspection and layout by three-dimensional projection of accurate layout drawings upon a rough casting has effected considerable savings in time and material Moreover, an unskilled operator with but a few days training can employ the method whereas the usual bench layout requires inspectors familiar with machining practice

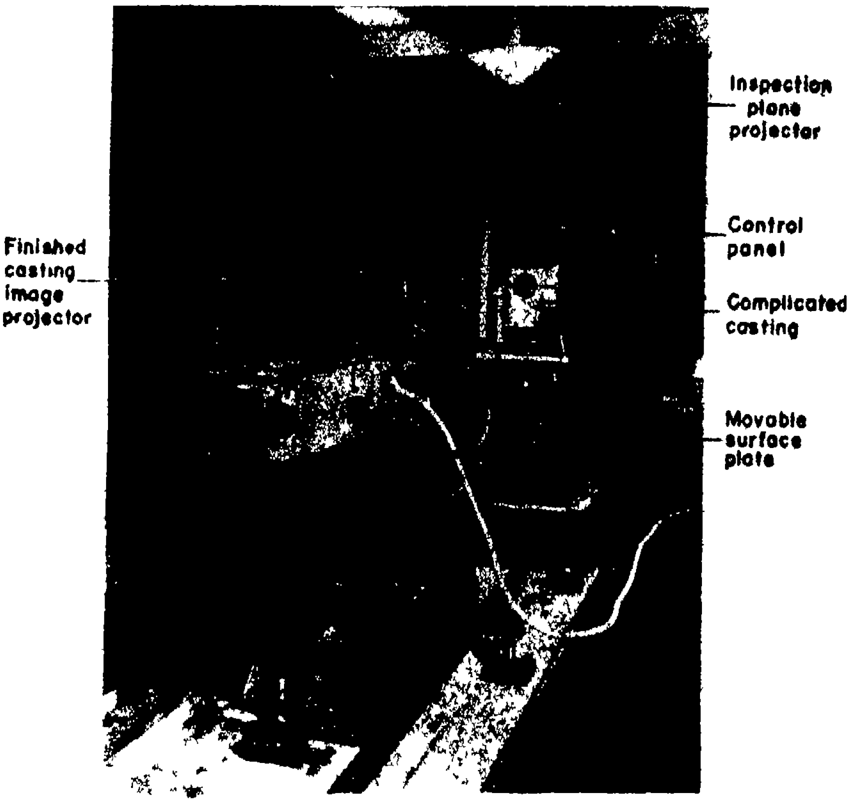
Originally designed to inspect and lay out parts for subsequent machining this method has also been used for rapid inspection of finished parts Projection may also be employed during an actual machining process whether the part to be machined is stationary or revolving The equipment assures layout accuracy within 0 015

The installed apparatus developed by the General Electric Company, consists of a layout image projector containing a photographic glass slide of the finished casting layout The layout is projected by a lens directly upon the surface of the casting To establish the plane of true projection and correct dimensions an inspection plane projector is used to emit a sheet of light which falls vertically upon the casting

When machining a piece which revolves and is symmetrical about the axis of rotation, the finished outline may be projected to serve as a template

This template-projection system may be used in fabricating duplicate metal parts for tanks, boilers, and other burned-out and welded pieces Variations of this system can be used for laying out intricate pieces locating parts to be welded, shearing and general layout operations

To make this three-dimensional method practical, drawings of finished casting which are suitable for photographing, are prepared The size and focus of the drawing image on the ground glass of the camera are checked by microscope for accuracy



Set-up for projecting layout drawings on casting in background

New Products

MINIATURE SWITCH

Features Snap Action and Precision Operation

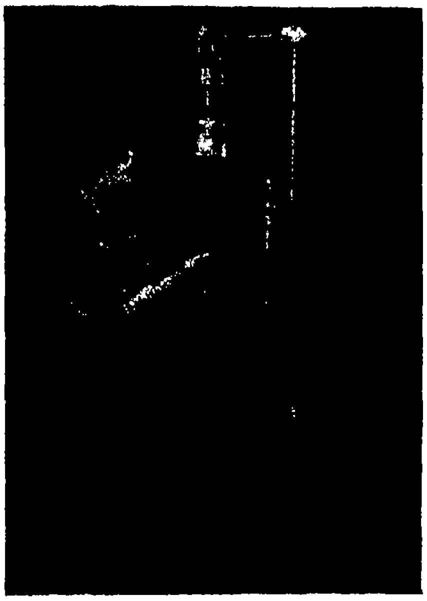
No larger than a dime, a new snap-action precision switch has as its outstanding characteristics compactness and rugged construction. Particularly adaptable in meeting specifications where space is at a premium, it serves ideally in the electrical circuits of dispensing machines, electric irons, linotypes, photographic timers, automatic washing machines, dictating equipment, and countless other consumer and industrial electric mechanisms.

Known as Q-Switch, it has high current-carrying capacity, and is designed to meet any circuit requirement— normally open, or normally closed, single- or double-throw, single pole. A product of the Mu-Switch Corporation, Inc., its electrical rating meets all Underwriters Laboratory requirements.

MULTIPLE DRILL UNIT

Shows Increase in Gas-Burner Output of 1600 Percent

Completing 385 holes simultaneously in a gas burner, a gearless, hydraulic drilling unit turns out an average of 30 burners per hour for an eight-hour day, where before its installation, 15 buners per eight-hour day was the best possible production. Standard threaded shank drills are used in this operation.



Only one operating lever

To remove or install a new set of drills, the operator needs only a pair of pliers, and the change can be made in matter of minutes.

The entire drilling cycle of the unit, product of Zagar Tool, Inc., is controlled by one operating lever. A hydraulic pumping system in the base of the unit operates the motor which runs the drill-head, as well as the ram that brings the casting up to the drill-head. This ram moves upward quickly, then automatically slows to a predetermined rate of feed as the spindles start to revolve. After the burner is drilled, the ram returns quickly to a normal position and the entire machine comes to a halt, completing one drilling cycle.

SOLENOID MOTOR

Produces Constant Torque Instead of Thrust

Operating as a solenoid except that it rotates through 180 degrees, a power device produces torque instead of thrust and consequently eliminates the necessity of connecting linkages. The armature of this unit is so designed that it maintains a constant heavy-duty torque throughout its entire 180-degree travel. Originally designed for the operation of radio tuning units, especially in automobile receivers, the unit called Rotonoid, has widespread application in many fields ranging from electromagnetic valves to adding and calculating machinery. The entire unit is self contained, measuring approximately 2½ by 2⅝ by 3¼ inches high and weighing 10 ounces. Standard Rotonoid units now in production have a torque of 16 inch-ounces and can be operated continuously at 20 cycles per minute without exceeding a safe temperature. Where faster action is advisable, they can be used at 60 cycles per minute for periods up to 12 minutes on 115 volts, 60-cycle A.C.

Torque through 180 degrees

When the Rotonoid is equipped with a current interrupter operating automatically at stroke completion, the temperature rise may be held to a minimum. This means may be employed to energize the coil for the necessary time only, and a relay attachment for this purpose is available.

SOLDERING TOOL

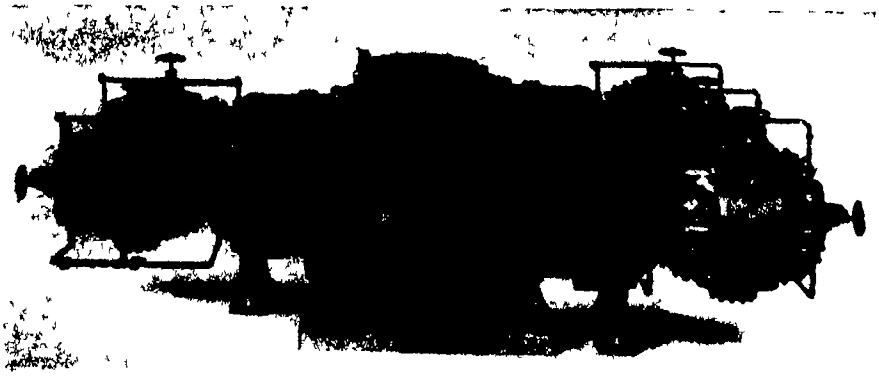
Is Compact and Portable, Will Not Over-Heat

Operating on the resistance heating principle, a redesigned soldering tool heats 20 percent faster, has thumb switch for close heat control, is lightweight, compact, and portable, and can be used for long periods of time without overheating.

Rated at 1600 watts

Built to industrial standards, the complete unit includes a transformer or power unit and a soldering tool that operates like a pair of pliers. Holding the work with the plier tool completes the transformer secondary circuit and causes the work to heat instantly. No pre-heating is necessary. Heat is produced between the electrodes of the soldering tool only, thus concentrating it on the exact spot needed. There is no danger of melting nearby joints or burning other parts.

Handles of the soldering tools, produced by Ideal Industries, Inc., are made of light-weight plastics. Radiating fins isolate the Meehanite jaws from the handles to prevent excessive heat conduction. The plier can be locked in any position for special applications by tightening screw at hinge. Secondary leads, made of super flexible power cable and insulated with light-weight woven asbestos, are attached to the side of the jaw for easy handling and cooler operation. The plier is intended where work may be held in the jaws and heated—for example, in removing or applying solder lugs, sweating and



Can be powered by turbine, engine, or synchronous electric motor

unsweating copper pipe and fittings, soldering wire joints, and so on Called Thermo-Grip soldering tool, it is rated at 1000 watts

FIREPROOF FABRICS

Made From Flexible Glass-Asbestos Combination

Developed for use in theaters, nightclubs, restaurants, auditoriums, airplanes, trains, and similar places of public assembly, fireproof drapery fabrics of asbestos and glass are said to be exceptionally light in weight and to have excellent draping qualities They will be produced in the form of gray goods suitable for dyeing and printing in a variety of colors and patterns

The asbestos-glass fabric, developed by the United States Rubber Company, is the outgrowth of war-time research on fire-resistant materials for industrial use Asbestos and glass complement each other when woven together, making a fabric with high flexibility and strength, low stretch with good resistance to abrasion, and stability under atmospheric changes

PACKAGED DIE CASTER

Simply Constructed, Is Easy To Operate

Completely self-contained, an air-operated die casting machine fills the need of many firms who require intermittent production die-casting work but without the facilities or need for establishing a regular die-casting division This machine, needing only the simplest possible installation, measures 22 inches by 72 inches, and is 40 inches high No special maintenance crew is required to adjust and maintain the die caster Likewise, no specially trained die-casting technician need be hired to operate it The average shop employee can handle production runs on this "goose-neck" type machine, the maximum casting capacity of which is one and a half pounds, with a possible maximum of 720 shots per hour

In construction, the die-casting unit, manufactured by the Robert A Cox Company, features single hook-ups for air, gas, and 110-volt current. It comes furnished complete with necessary blow torches for properly heating both goose-neck and nozzle The holding pot has a capacity of 300 pounds of zinc alloy It is cast of Meehanite iron and is designed in such a manner as to provide maximum heating area for the metal at all times The furnace is lined with four and one half inches of fire brick insulation A safety vent is also provided to take care of any metal which might get into the furnace by accident

Simple operation throughout is an outstanding characteristic of the Cox machine It is equipped with a loose-type nozzle, instantly removable A removable bar facilitates die loading All working parts are readily accessible for inspection, adjustment, or maintenance Zerk fittings are conveniently located so that all bearing faces may be properly lubricated By installing this completely self-contained die-casting package, the average small and medium sized metal working shop, or any manufacturing plant making products requiring die casting, saves on job-shop costs, reduces inventory expense, and is provided positive overall production control

No trained casting operator needed

AIR COMPRESSORS

Available in a Variety of Sizes and Capabilities

Manufactured in six sizes and with a great variety of compressor cylinders a motor-driven compressor of new design offers a wide range of volumes and pressures for handling air or gas It is built with from one to six crank throws and ranges in horsepower from 500 to 2750 The compressor stroke is 14 inches and it operates at 300 revolutions per minute Power for driving can be taken from a standard synchronous electric motor, an engine, or a turbine The lubricating system, which includes a pressure pump and a built-in filter and cooler, furnishes oil under pressure to all moving parts

Provision can be made for low vacuums or for high pressures, as well as for all intermediate pressures, enabling the selection of precisely the proper size and type of compressor cylinders for any desired volume and pressure within the horsepower limit of the unit The low- and medium-pressure compressor bodies are of Meehanite metal, while high-pressure bodies are of cast or forged steel as required The cylinder valves are of a standard ring-plate type and are self-cleaning Valve seats are renewable, and interchangeable from suction to discharge

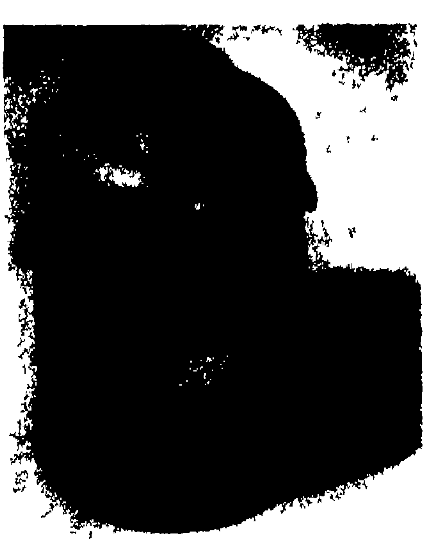
Electrical or mechanical unloading by means of compressor suction valve lifters is also available, offering automatic control of flow or pressure Automatic starting can be provided and compressor cylinders can be automatically unloaded for easy starting Bearing temperature shut-down, low lubricating oil pressure shut-down and various other controls are available, depending upon the type of installation

Dimensions of the compressor, designated by its manufacturer, the Cooper-Bessemer Corporation, as Type JM, range from 11 feet 7 inches to 24 feet 6 inches in length, and from 13 feet 9 inches to 24 feet 2½ inches in width These lengths may vary slightly depending upon the size motor used, while the widths may vary according to the type of compressor cylinder used

VERTICAL MOTORS

Have Positive Lubrication, Hollow Shafts

Available in ratings from one to 500 horsepower, all speeds and frequencies, a hollow-shaft vertical motor designed specifically for pump drives is suitable for use on irrigation projects, deep-well turbine pumps, municipal and industrial water-supply projects, mine-



Protected from self-damage

dewatering pumps, and process- industry liquid pumps

For motors rated at 10 horsepower, 1800 revolutions per minute, and larger a system of controlled lubrication is featured, which allows just the right amount of oil to flow through the bearings, thus preventing oil-friction loss caused by foaming and churning Bearings are protected from rust even during standby periods because the oil level is above the top of the balls

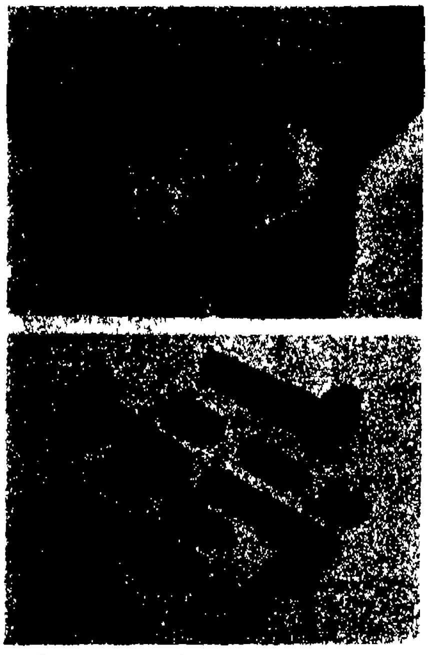
A large oil reservoir cast integral with the motor end-shields has sufficient capacity to allow the oil to cool and recover before being recirculated A close-running fit between the end shield and couplings protects bearings and oil reservoir from the entry of dirt even when the top cap is removed for pump adjustment Motors of 7½ horsepower, 1800 revolutions per minute, and smaller have grease-lubricated bearings

Bearings, punchings, and windings of these new General Electric motors are cooled by a double-end ventilation system which draws in air at both ends of the motor and discharges it through openings in the stator frame A protective "self-release" coupling prevents damage to the pump or motor caused by motor reversal This consists of a top half-coupling keyed to the pump shaft and a lower half-coupling keyed to the motor shaft It reduces installation time and provides a simple method of checking motor alinement

PLASTICS GUARD

Protects Finished Parts While in Transit

To insure that the ultimate consumer receives metal parts in "factory fresh" condition, a novel protective system has been devised by the Jergens Tool Specialty Company After the part to be shipped has been thoroughly oiled as a guard against oxidation, a tough plastics coat known as Seal-Peel, which is easily removed by the consumer, is placed over the portions most subject to damage Thus the part is kept absolutely clean, and damage to ground surfaces, threads, and so forth, as a result of shipping or handling, is virtually eliminated



Protects machined surfaces (above) or threads (below) from dirt, damage

COLD-STORAGE PAIL

Uses Fiberglas-Plastics Insulating Liner

Easily portable, a container for iced storage of fish and game is provided for sportsmen by a Fiberglas-insulated, plastics-protected liner designed to be used inside the familiar 10-quart galvanized pail Known as the Pailmaster, it has a removable top of Fiberglas insulation, encased in a sealed plastics cover and held in place by a braided draw-string passing through nickel-plated grommets To insure rugged construction, all seams are electronically welded to form a homogeneous plastics protection for the inch-deep Fiberglas insulation

As pail cover (left) and liner (right)

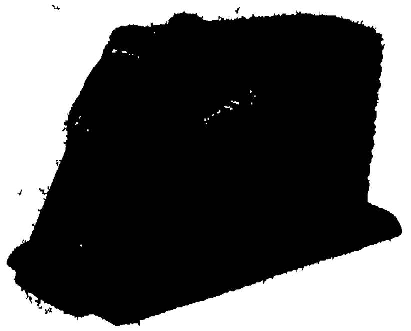
A typical test of the high efficiency of the Pailmaster was the placing of 150 ice cubes in the closed unit for 15 hours at a room temperature of 70 degrees, Fahrenheit At the conclusion of the test, all the ice cubes were still large enough to use in the preparation of cold drinks

The Pailmaster, manufactured by Plastic Sheet Fabrication, Inc, is also available in a design which provides insulation for the entire exterior of a standard galvanized pail In this form it converts the pail into a container for frozen foods, ice cubes, milk and other foods requiring refrigeration, and provides equally satisfactory storage for hot drinks and hot foods

TAPE DISPENSER

Ejects Measured Strips of Adhesive Material

For use with transparent or colored pressure-sensitive tape in all widths up to one inch, a definite length dispenser takes either a one- or three-inch tape core By simply setting the indicator on the side of the machine to the desired length and then pressing down the lever, the tape is ejected—cut off and ready for use in lengths from ⅜ to three inches A variation for use in production lines can be made by adjusting the dispenser to cut long strips which are perforated at required lengths



Cuts strips from ⅜ to three inches

The piece of tape rests on a "waffle' wheel at the front of the dispenser, and is easily lifted for whatever application is desired The cutting of the tape into short lengths needed will bring about tremendous economy over the present wasteful, hit-or-miss hand method The machine operates equally well with either cellulose or acetate fiber, and with all makes of pressure-sensitive tape

This dispenser, called Tape-Saver, is a product of the A-L-B-E-Engineering Company and is expected to fill a need in factories, shipping rooms, mail rooms, offices, and on wrapping counters in retail stores

HIGH-SPEED CORE DRILL

Has Coolant Supplied Through Stem to Abrasive Rim

Designed to drill holes of any depth within the length of the drill and in all hard, brittle, non-metallic materials, a new core drill achieves exceptional drilling speeds due to the method of supplying coolant through the drill stem to the special metal-bonded diamond abrasive rim Chips and sludge are flushed from the kerf as fast as developed, and since the coolant supply is constant, the drill functions without heat, regardless of the hole depth The core drill may be used in drill presses, on portable electric drills, or directly coupled to motor shafts It operates in any position with equal efficiency, and usually requires only a few seconds per inch of travel when drilling most materials

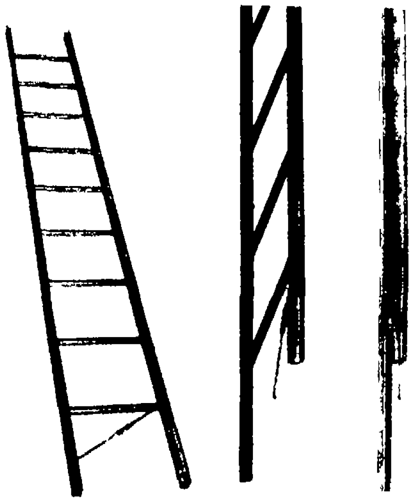
Once seated, the drill, called the Di-Met Core Drill, travels in a straight line and, with care, unbroken cores of any length within the drill capacity are easily produced On most operations coolant from the local water main is satisfactory When drilling exceptionally hard materials such as petrified wood, special coolants or additives, such as a soluble oil, may be preferable The supply is connected to the coolant head through a flexible rubber hose and this head remains stationary during drilling operations It is packed off both above and below the port of coolant entry

The complete drill head assembly, a product of the Felker Manufacturing Company, consists of a collet drill shank, a coolant head, which slips over the shank, and individual collets to which the drills are attached Drill collets readily detach from the collet drill shank, permitting free access to either end of the core drill Tight cores are thus easily ejected

COLLAPSIBLE LADDER

Folds Easily, Takes Little Space in Storage

LIGHT-WEIGHT and completely collapsible, a ladder whose rungs are made of aluminum tubing, and with side rails of extruded aluminum, weighs approximately 40 percent less than conventional wood ladders of the same length When not in use, the two side rails fold together and the rungs fit compactly within the extruded sections making the ladder easy to store and carry in close quarters When folded the ladder takes up less space than a two by four timber A simple snap-action locks the ladder firmly and safely in either open or closed position These ladders are made by the Gepfert Manufacturing Company in all standard lengths up to 28 feet, in either single or extension type



Open **partially folded** **folded**

REPLACEABLE HAMMER TIPS

In Three Hardnesses Extend Tool's Versatility

AVAILABLE in three grades of hardness, replaceable tips for a series of hammers are stamped "soft," "medium," and "hard" so that the operator can quickly select the tip needed for the particular job at hand While in use, tips are locked firmly in place

While these replaceable tips add to the versatility of the hammer, they are also an economy feature, since the hammer's life may be extended by inexpensive replacement of the tips

Unlike rawhide and rubber hammers, these tips have virtually no rebound or sting, a feature that not only makes them less tiring to use but also more accurate The tips are made of "live" material called Nuplaflex that retains its shape under the most severe punishment In tests they are reported to have regained their original form after being crushed flat by 20 000 pounds of pressure The tips are chip-proof non-explosive, and will not flash burn

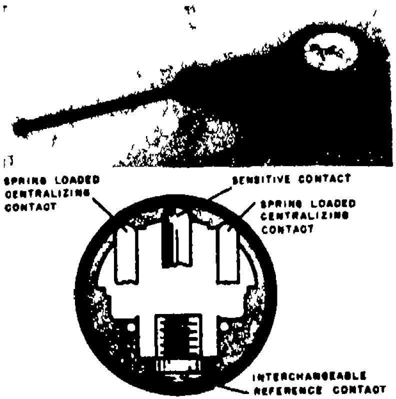
Called the Nupla Hammer by its manufacturer, The New Plastics Corporation, it is designed as an all-purpose tool for mechanics, machinists, auto body repairmen assemblers - wherever a "soft" faced hammer is required It is available in five sizes and ten weights

HOLE GAGE

Features Self-Centralizing And Readability

REVEALING size variations in tenths of thousandths, a new small hole gage makes possible thorough inspection of inside dimensions between 250 and 500 inch The spring-centralizing design plus precise measuring contacts and motion transfer units locate themselves in the hole and show the true diameter reading with a high degree of accuracy The gage employs 14 interchangeable extensions to cover the full range from ¼ to ½ inch It explores any hole within its capacity to a maximum depth of 2¼ inches, revealing diameter and also roundness, taper bellmouth, and other hole inaccuracies

Used as a single-purpose inspection tool or for checking a large variety of sizes, it shows precisely and sensitively how much a dimension varies, and not merely whether it's in or out of tolerance Being a point-to-point contact gage, it reveals any small area imperfections in the hole All contacts, both measuring and centralizing, are hard chrome plated and carefully radiused for long-lasting accurate service Called Model 1204 by its manufacturer, the Federal Products Corporation it is extremely light and fits the hand comfortably


SPRING LOADED CENTRALIZING CONTACT
SENSITIVE CONTACT
SPRING LOADED CENTRALIZING CONTACT
INTERCHANGEABLE REFERENCE CONTACT

Employs 14 interchangeable extensions

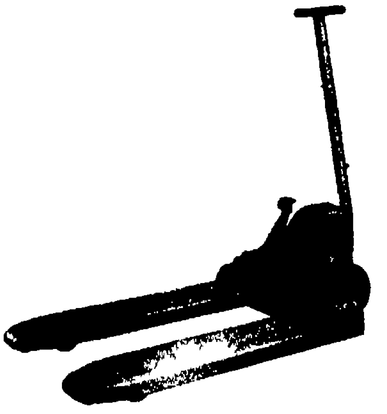
The gage comes complete with adjusting wrenches and the extension or extensions required It is easily adjusted for a particular dimension with a master ring of the proper size

The inspector can readily see dimensional variations as small as 0001 inch or as large as plus or minus 004 inch on the indicator dial

PALLET LIFT TRUCK

Is Easily Elevated With Hydraulic Foot Pump

STRONG but light-weight, a pallet lift truck has a frame constructed of sheet steel formed into box sections, with wheels and other non-structural parts made of aluminum alloy Elevation is accomplished by a hydraulic foot pump whose stroke length is dependent upon the stature of the operator By pushing the foot pedal forward, the lift, a product of Lyon Raymond Corporation, is lowered The pump is equipped with a relief valve to prevent overloading and possible damage



Relief valve prevents overload damage

CUTLERY HANDLES

Of Birch-Plastics Laminate Resist Heat and Acids

HARD enough to be used as a metal-forming die during the war, a compregnated wood and plastics material is now being used for household cutlery handles The new material, called Pakkawood, has been in use since early last year and has shown excellent qualities of durability, and heat- and acid-resistance The new material retains its original luster even after continuous soaking in dish water For many years the cutlery industry has been experimenting with materials for household cutlery handles that would retain their original color and lustre in use Most handles were made of imported hard woods Pakkawood, which during the war was also used to make propellers for training aircraft, is made of thin layers of birch wood that are immersed in baths of liquid plastics The wood is then stacked in layers and compregnated in presses that develop over 600 tons pressure to form solid blocks

This material is also being used for cutlery cases containing the new self-sharpening carving knives currently being manufactured The knives are completely encased in Pakkawood blocks which contain carborundum sharpening hones and automatically sharpen the knives as they are removed or replaced

DRILL AS LATHE

Combination Made Possible by Simple Attachment

Converting any bench or floor model drill press with a column either 2½ or 2¾ inches in diameter into a wood turning lathe, a unit known as Dril-Lathe is easily and quickly installed as a permanent part of the drill press

As lathe, takes work up to 36 inches

Conversion from one position to the other is accomplished in a matter of seconds by simply loosening one bolt and indexing the drill press head and lathe bed in the positions desired By combining the two tools in a single unit, a considerable amount of floor or bench space is saved, as is the cost of a second electric motor

Installation of the Dril-Lathe, a product of the Nobur Manufacturing Company, on the conventional drill press requires only the removal of the standard drill press column for replacement by the two-piece pivotally connected tubular column furnished as part of the unit's assembly No further changes are required, and the utility of the drill press is in no way altered When moved to the lathe position, the converted tool can handle all types of wood turning, and will take work up to 36 inches in length

OSCILLATING COMPRESSOR

Has High Output, Can be Adapted to Many Uses

Having only four major driving parts, a new oscillating compressor produces an unusually large volume of air with a comparatively low horsepower motor running at a low speed The two cylinders of this compressor are each divided into four compartments by two stationary vanes and one oscillating rotor which is fixed to the rotor shaft Thus an equivalent of eight-cylinder performance is achieved A test model weighing 350 pounds, with a bore ten inches in diameter and nine inches deep, was run at 235 revolutions per minute It produced over 500 cubic feet per minute of free air at room temperature, an output reported to be 10 times that of conventional compressors of comparable size And after having run for eight hours with no cooling device, the temperature of the compressor was found to be only 100 degrees, Fahrenheit Vibration is so low that a coin balanced on the compressor's housing remained poised during the entire test A 20 horsepower, three phase, 220 volt motor was used for the test

This compressor, developed by Associated Engineers, Inc, is expected to find wide application where conventional models are impractical because of weight and size It can be adapted to refrigeration, hydraulic, ventilation, and stage booster pumps

WARNING LAMP

Easily Installed, Features Automatic Blinking

Containing all the necessary elements including the flashing mechanism, an attention-arresting panel warning lamp blinks automatically when activated The lamp is easily mounted in a single hole, with a grounded panel, only one terminal wire is required Standard lamp bulbs are used, and are readily accessible from the front of the panel Manufactured by Jersey Technical Enterprises, the device is known as Blink-O-Light, and is available in a variety of sizes and voltages

Can be mounted in a single hole

V-BELT CLUTCH

Provides Shockless, Easily Controlled Load Pick-Up

Designed to grip or release directly on the V-belt, a clutch unit, complete in itself, may be used either as a driving or a driven pulley In operation, the positive, smooth clutching action is the grip of the sidewalls of the pulley against the belt. When the clutch is opened, the belt slackens and idles on a free-running, grease-sealed, ball-bearing, with no attendant belt drag or creep One fixed flange of the V-belt sheave is an integrally attached part of the hub and the inner race of the sealed ball bearing belt idler, as shown at point Number 1

Four free-rolling steel balls (Number 2) rides in grooves in the hub and carry all turning and locking forces The balls are carried forward by the sliding clutch sleeve or movable flange (Number 3), and drop into pockets at the ends of their grooves The cam sleeve (Number 4) then moves over the clutch sleeve, and locks the clutch against the balls in driving or driven position All parts turn with the shaft.

Driving or driven pulley

The engaging action which grips the belt and at the same time forces it away from the idler bearing and into working position is smooth and shockless in load pick-up

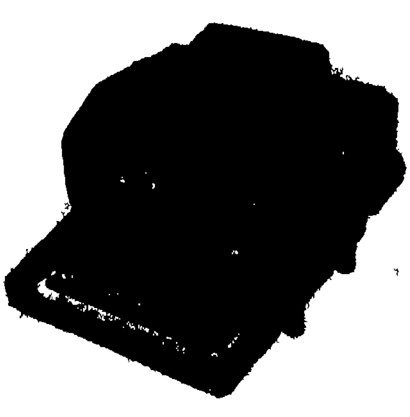
A stop ring prevents over-travel of the cam sleeve in disengaging action The cam sleeve carries a projected flange on which a shift collar is mounted, in its turn actuated by a shifting fork

Known as the Ball-lok V-Belt Clutch, it is manufactured by the V-Belt Clutch Company and is suitable for application in connection with internal combustion engines, motors, tractors, and many types of machines where compactness, light weight, and controllability are requirements

TELEGRAPH WRITER

Permits Inexperienced Operator To Send Clear, Rapid Code

Fully automatic, a telegraph code writer will send perfect telegraphy in any code from two to 60 words per minute Since the code writer is similar in appearance and operation to an electric typewriter, even inexperienced operators can send flawless and easily-understood code Unaffected by centrifugal force, it may be operated on



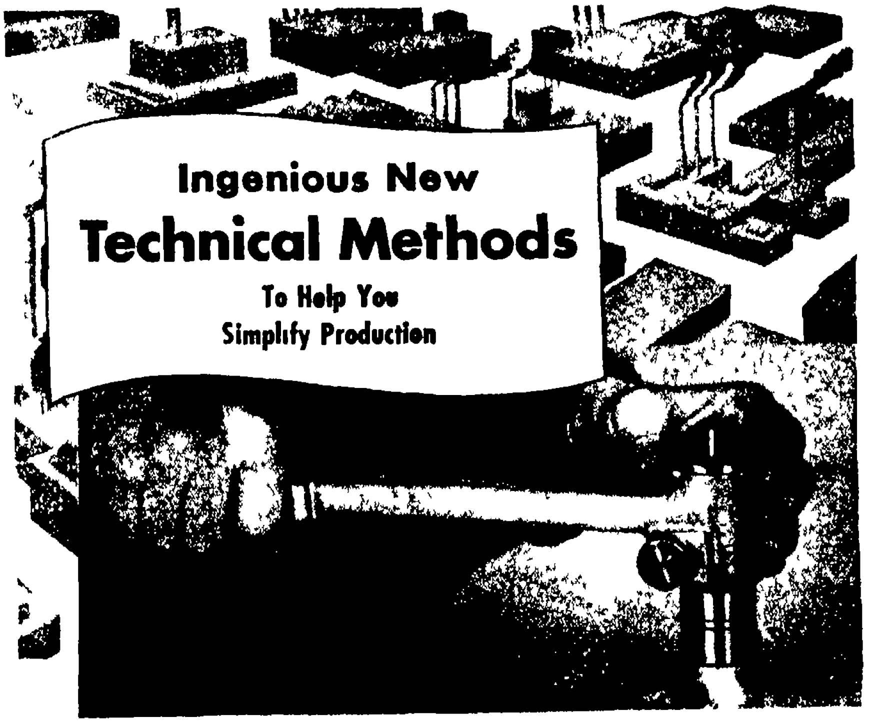
Can also be used for code instruction

ships, in airplanes, on trains or automobiles Nervous strain and the "swing" of operators are entirely eliminated

A repeat key on the code writer, produced by the Selectograph Manufacturing Company, makes possible self instruction at any speed desired An electronic oscillator and loudspeaker monitor (which may be replaced by a sounder) with jacks for head phones or a remote loudspeaker affords easy instruction and invaluable aid to classroom instructors The speed of transmission is controlled by a speed selector and a calibrated speed indicator mounted on the instrument

The Selectrograph Code Writer is motor driven and may be equipped for any A C or D C voltage specified Machines are available for International Morse Code American Morse Code, or any other type of code Ciphers may be easily adapted to the instrument for secret transmissions using standard codes, by changing cams, or by use of private code ciphers Code is sent by the instrument through a series of cams operated by friction drive An interlocking key mechanism prevents striking a key while a cam is in motion

Standard equipment includes volume control and switch, three position tone control, and indicator lights Later models will include tape recorders for recording code transmissions or for preparing tapes for transmission



Ingenious New
Technical Methods
To Help You
Simplify Production

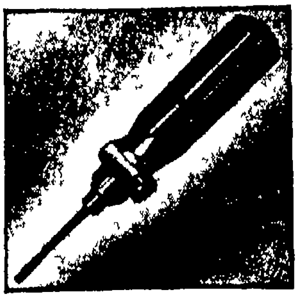
New Type of Torque Tools Incorporate Spring Clutch!... Are 98% Accurate!

Acme Torque Wrench and Screw Driver both incorporate spring clutches, with easily operated control After setting control to desired torque, the operator merely turns tool in the usual way When the torque required to drive the threaded part exceeds the pre set value, the tool slips Impact doesn t cause driving torque to increase Oil doesn t affect setting which is reproducible within 2% or better

The Wrench offers right and left hand drive, ratchet action and withdrawal Spring clutch may be set from 0 to 500 inch pounds Standard sockets are interchangeable The Screw Driver may be set for any value of torque from 0 to 35 inch pounds A ratchet action is incorporated The same tool will also withdraw screws Standard bits including socket types may be easily inserted The tool is made of pressure cast aluminum

Another Time-Saver on the job, is chewing gum The act of chewing aids the workers concentration—seems to make the work go easier Chewing gum may be used even when workers hands are busy reducing interruptions from the job For these reasons many plant owners have made Wrigley s Spearmint Gum available to everyone

You can get complete information from
Acme Scientific Company, 1450 W Randolph St Chicago 7 Ill



Torque Screw Driver

AB 64

PARTICLE COUNTER

Detects Dust and Bacteria In Air By Noting Scattered Light

AUTOMATICALLY counting individual smoke particles or bacteria as small as 25 millionths of an inch in diameter and weighing only four millionths of a billionth of an ounce, a new photoelectronic instrument is expected to be useful to the research bacteriologist in testing contamination, and in many industrial plants producing pharmaceuticals, such as penicillin or streptomycin, or chemicals, such as alcohol or acetone, by fermentation The counter also may serve in detecting dust which must be excluded in the manufacture of photographic film and fine optical instruments

When sunlight streams through a window into a darkened room, the sparkling motes of dust are clearly visible, because of the light which they reflect and scatter All suspensions of finely divided materials in air called "aerosols," show this property of scattering light This is true whether the material be transparent or opaque, solid or liquid

The new instrument utilizes the light scattered by the microscopic particles A brilliant light is concentrated in the center of a black-walled cell by means of a condensing lens. A stream of air containing the suspended particles—of smoke, for example, or bacteria—is passed through this bright spot, and each particle signals its presence by a flash of light An electric eye, arranged to view these flashes, translates each into a tiny electric pulse, which is amplified 200,000 times by an electronic circuit

The amplified pulse then is fed to a trigger tube which gives a large enough surge of current to actuate an electromagnetic counter Thus each pulse advances the hand of the counter one division on a circular dial, which is graduated from zero to 100

The apparatus, originally designed to check the filters of American service gas masks by detecting the passage of even a few microscopic particles, can serve as a supersensitive filter tester If one particle out of every 10,000,000 in a concentrated test smoke passes through a filter, its presence can be detected

Experiments carried out with airborne spores of bacillus globigii showed that these could be counted satisfactorily The device, built at Northwestern University, is being tested to determine its usefulness in counting other airborne bacteria For those bacteria which are not too small, the counter may supply the bacteriologist with a method of determining the concentration of bacteria in the chamber in which his test animals are placed under carefully controlled conditions

Unfiltered laboratory air passed through the apparatus gives more than 1000 pulses per minute, more than can be counted by the instrument in its present stage of development Hence, the counter is extremely useful now in detecting small leaks of room air into systems in which the air is supposed to be filtered carefully In testing con-

CHANGING TIMES SHOULD BE SUCCESSFUL TIMES FOR EXECUTIVES!

Today, war worries have been succeeded by an atomic turmoil Far-reaching changes have always followed wars—and the man who has kept pace always comes out on top

Come what may, one need is never completely filled—the need for competent executives to direct business and industry In tumultuous times like those of today, this demand multiplies Right now, the outlook for ambitious men is brighter than ever before—if they have the training to take advantage of opportunities

The training needed is not narrowly specialized, but goes broad and deep, probing the basic principles that underly *all* business It provides the knowledge that enables men to direct the activities of others not in one department or one kind of business, but in *any* business It supplies the "know how" that enables top executives to manage *any* business

How to get such executive training

Training of this kind is provided by the Modern Business Course and Service of the Alexander Hamilton Institute The Course covers the four major functions of business—Production, Marketing, Finance and Accounting It turns out not accountants, or salesmen or production men, but *executives!*

Takes months instead of years

This knowledge takes years to acquire by ordinary methods Through Institute training, the process is concentrated and thus finished in a matter of months It does not interfere with a man's present position, being taken at home, during spare hours More than 430,000 men have subscribed, many call it "a turning point in their lives"

Many prominent contributors

One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors Among them are such men as Thomas J Watson, President, International Business Machines Corp , Frederick W Pickard, Vice President and Director, E I du Pont de Nemours & Co , Clifton Slusser, Vice President, Goodyear Tire & Rubber Co , and Herman Steinkraus, President, Bridgeport Brass Company

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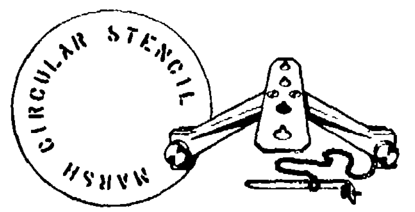
tamination of a system in which sterile conditions are required, the presence of a trace of room air will show up instantly on the counter, while in the usual bacteriological count, involving collection, culturing on an agar plate, and counting of resulting bacterial colonies, it will not appear until hours later

CIRCULAR FEED ATTACHMENT

Facilities Change From Straight To Round Stencil Cutting

Shippers of barrels, drums, pails, or similar articles, will find a circular feed attachment for stencil-cutting machines a convenience Quickly and easily installed the attachment enables instant change-over from cutting straight to circular stencils, and vice-versa Developed by the Marsh Stencil Company it is adjustable to permit cutting three line addresses or copy in inside diameters of 11, 14 17, or 20 inches Letters are spaced automatically and accurately, and word spacing is the same as when cutting a straight stencil



Three lines of copy possible

STAINPROOFED TEXTILES

Quickly Cleaned by Wiping With Damp Cloth

Fabrics which can be quickly wiped spotless and clean of spilled foods and beverages are made possible by the applications of a new stain-repellent chemical which can be applied to wool, cotton, rayon, aralac, nylon, acetate, and to mixtures of these fibers Primarily developed as a water repellent, the new product differs from ordinary repellents in that it enables the fabric to retain all of its original strength and beauty after it has been treated, and ordinary liquids and foods can be wiped off with a damp cloth with no effects apparent in the fabric

Application of repellent wool fabrics in new planes of American Airlines enables the line to serve meals aloft without risk of staining the planes' interior fabrics, the fabrics will apparently retain their wool gabardine appearance indefinitely

The chemical, developed by the Monsanto Chemical Company, is applied within individual fibers of a fabric which thus retains its original look together with its ability to "breathe"

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Complete Optics! Complete Metal Parts!

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OPTICS—Set includes all Lenses and Prisms you need for assembling 7 x 50 Binoculars These Optics are in excellent condition—perfect or near perfect—and have new low reflection coating
Stock #5102 S 7 x 50 Optics **$25 00 Postpaid**

NOTICE! Add 20% Federal Excise Tax to above prices if you order **both** Binocular Optics and Metal Parts

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COMPLETE OPTICS & METAL PARTS — Model M 13A1 Waterproof Model 6 x 30 Binoculars Everything you need — ready for assembly When finished will look like a regular factory job costing $102 to $120 The Optics are new in perfect or near perfect condition Have new low reflection coating Metal parts are new and perfect all completely finished No machining required Bodies factory hinged and covered Complete assembly instructions included
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plus $8 00 tax — Total — $48 00

NOTICE! Add 20% Federal Excise Tax to above prices if you order **both** Binocular Optics and Metal Parts

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Same Unit Without Polarizing Attachment
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SCHMIDT OPTICAL SYSTEM Black plastic body size 3 15/16" by 5½" F L 24 with amazing speed of F O 9 Used in Navy s Infra Red Sniperscope and Signalling Units Gov t cost $134 Limit—1 to a customer
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MOUNTED PROJECTING LENS SYSTEM F L 91 44 mm (just right for 35 mm Projectors) Speed of F 1 9 Outside dia of mount at one end 60 mm Length of mount 64 mm
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MOUNT FOR ABOVE PROJECTING LENS SYSTEM
Stock #715 S **$1 50 Postpaid**

BATTERY COMMANDER S PERISCOPE With Tripod — 6 Power Instrument Excellent condition Length 27½ inches—diam 1½ inches Cost U S Govt approximately $175 00
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BOMBER SIGHTING STATION - A double end Periscope Type Instrument of highest precision 6 ft tall shipping wt 380 lbs Orig cost $9 850 Consists of numerous Lenses Prisms Mirrors Gears and Motors Metal parts and Electrical Gadgets
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2⅛" DIA ACHROMATIC TELESCOPE OBJECTIVE F L 20 inches (Not a war surplus item) The Govt used very few long focus Objective Lenses so we had these made for you First class lens suitable for Spotting Scopes Terrestrial Telescopes etc Not coated
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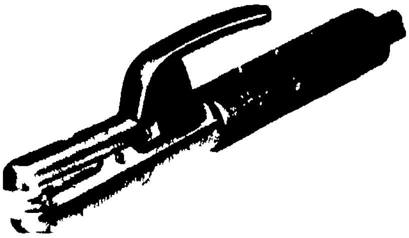
through inter-fiber spaces This quality is of increasing importance in future clothing applications, including use in men s suits The treated fabrics may be laundered or dry-cleaned with no reduction in their water-repellent and stain-resistant characteristics

COMPACT ELECTRODE HOLDER

Built To Withstand Heat and Shock

Designed primarily for the small job shop or the maintenance welder an electrode holder with a capacity of 250 amperes will take rods ranging in size from 1/16 to 3/16 inch Simple both in construction and operation the tool, made by Tweco Products Company and called Twecotong, weighs only 18 ounces and is nine inches long Tip and body insulation is of glass cloth impregnated with Bakelite, which offers high heat and shock resistance The cable connection is a simple clamp



Capacity is 250 amperes

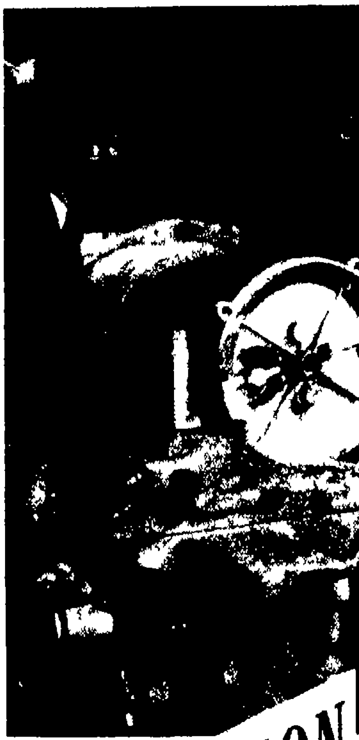
IMPROVED CONVEYOR BELT

Carries Heavier Load a Greater Distance

Moving coal, iron ore and other bulky materials over long distances, a new conveyor belt, 250 to 400 percent stronger than previous rubber-fabric belts, has as the key to its increased strength a new textile construction of nylon and Ustex yarn that increases the permissible working tension of each ply two and one-half times and permits the use of more plies The new product is especially designed for use in mines, quarries and large dam construction projects Carrying heavier loads than other rubber-fabric belts, it will extend the range of conveyors and eliminate many costly transfer points and extra driving mechanisms

In addition to greater strength, the new belt has the advantages of low stretch lengthwise and increased flexibility crosswise These two features make it possible to build a longer and heavier belt with a minimum of stretch and excellent troughing qualities The belt can be spliced easily and quickly, and repairs can be made promptly by conventional repair techniques

Ustex yarn is a development of United States Rubber Company textile scientists, and was used during the war to make Army parachute harness



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South Bend Lathe photo courtesy of Bendix Aviation Corp

Building Better Lathes Since 1906

SOUTH BEND LATHE WORKS

458 E. Madison Street South Bend 22, Indiana

WRITE FOR CATALOG 100-F

Describes South Bend Toolroom and Quick Change Gear Lathes with 9 , 10 , 13 , 14½ , and 16 swings; Precision Turret Lathes; attachments and tools.

SOUTH BEND LATHES

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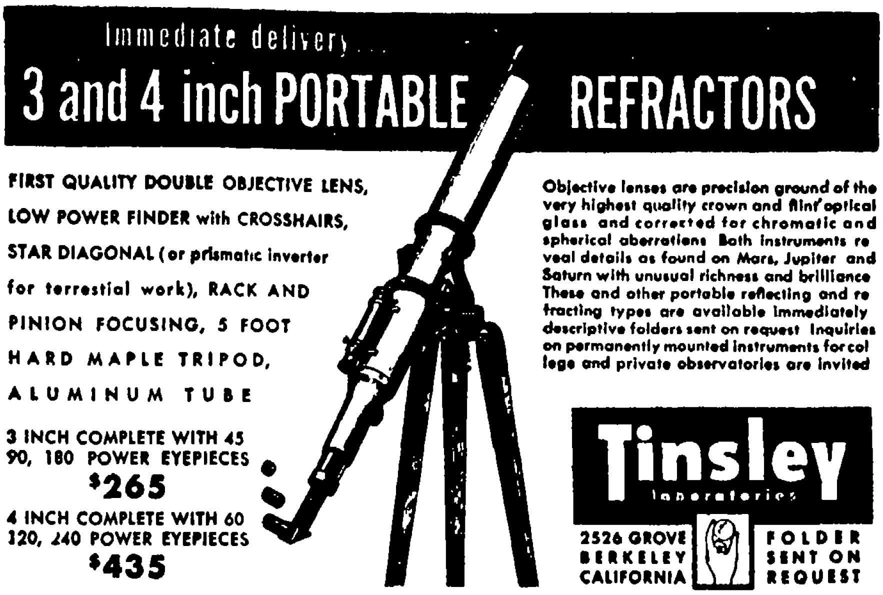
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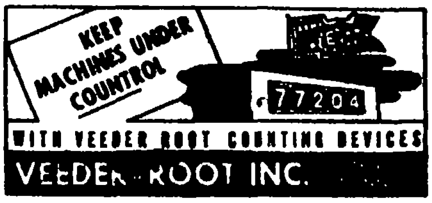
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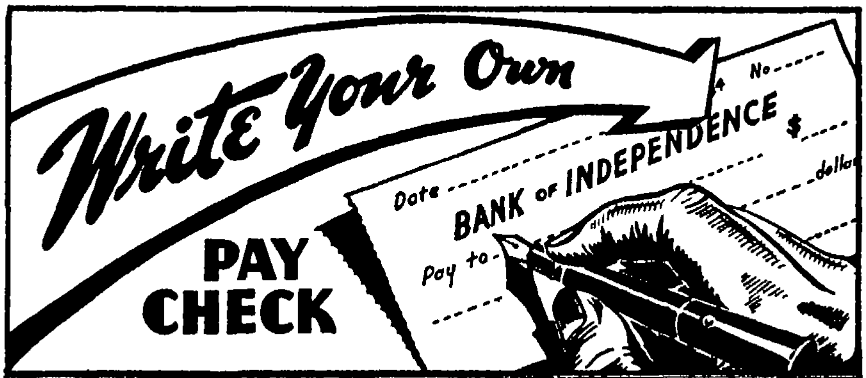
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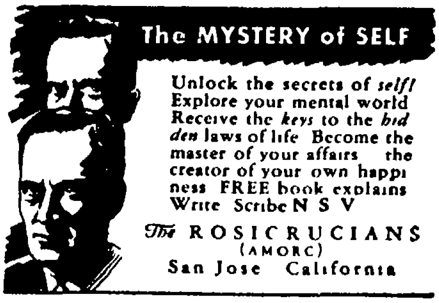

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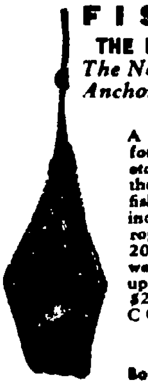

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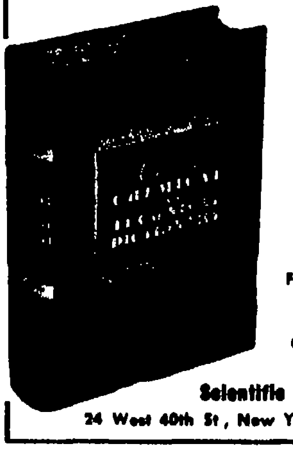

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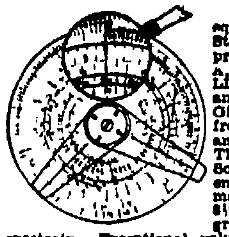

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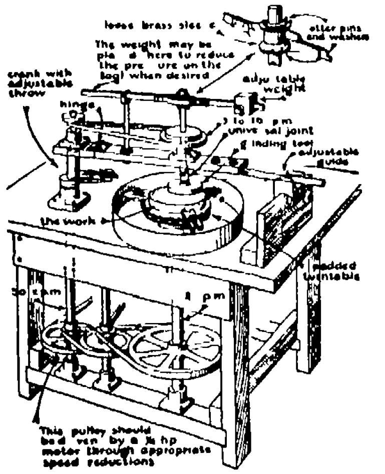
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This pulley should be driven by a ¼ hp motor through appropriate speed reductions

Figure 1: Mt. Wilson Draper

Probably a 16" mirror calls for a machine The Hindle machine is analogous with full-size-tool, mirror-on-top hand work. Neither method scientifically provides what Dévé in "Optical Workshop Principles" calls the "condition of uniform wear," hinted at by Driscoll in this space 1945, November Referring to the common mode of working, he wrote "On a concave surface a polisher having the same diameter as the work will have a tendency continually to shorten the radius of curvature, polishing the center more than the edge Therefore a hyperbola develops In trying to lengthen the radius and get out of this hyperbola the worker resorts to very short strokes and thus, by polishing the edge more than the center, he lengthens its radius and winds up with two foci"

Suppose, now, we substitute a machine (or analogous hand methods) using sub-diameter tools with such correctly chosen (1) size (2) stroke length (3) endwise decentering (4) sidewise offset, that the curve will sink as a whole—no change of radius, no zones of differing radii just uniformly thin slices off the mirror, curved of course This is the condition of uniform wear and you can learn the needed combination of the four factors named by experimenting a long time with an old mirror and connecting causes and effects, or by digesting Ritchey's classic "On the Modern Reflecting Telescope, and the Making and Testing of Optical Surfaces" (out of print, rare), or by reading this department next month Meantime, let's look at two modified Draper machines

There is no officially correct, ordained form for the Draper but the one shown in Figure 1, reproduced by permission from Strong, "Procedures in Experimental Physics" (Prentice-Hall, New York) is well regarded by many, though its trappy top hammer and slippy vertical crankshaft belt are regarded by others as details not to imitate The machine from which this drawing was made is still in use at the Mt Wilson Observatory Optical Shop and a tracing of Figure 1 was sent to Ralph Dietz, a former amateur then working there, to elicit comment He replied "The machine in Strong's book is the best type as far as I am concerned, I have used many but like this one best"

On specific details of this drawing he commented "The belt over the arm is used only in roughing out or fast grinding" Some find Drapers, like Hindles, are not fast excavators and suggest an auxiliary for hogging out, perhaps a hand lever spindle like "A T.M," page 163, Figure 3, C, with 5/6 diameter channeled glass tool or half-diameter ring tool (circle of glass blocks pitched to metal backing) Broadhead temporarily belts the motor directly to the turntable pulley, substitutes for the turntable a convex sub-diameter iron tool, face up, and holds the mirror by hand Or the Draper may be used normally but with as fast strokes as it will stand and the tool forcibly rotated (Note Universal joint in Figure 1 is used only for hogging out)

Dietz again commented "Arrange machine so that driving pin can be shifted along arm—very important and useful" This calls for a slot adjustment in the arm, see "A T M.," page 165, original Draper This in turn nullifies belt atop arm. A cone pulley there would, it is true, afford four positions but entire freedom would be still better For ordinary grinding and polish-

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ing, also figuring, Broadhead favors an entirely free tool, as does Ferson for all purposes. Ritchey insisted strongly on forced tool rotation. Numerous advanced amateurs today can match Ritchey in skill Take your pick, it's a free country An effect similar to decentering along slot may be had by off-centering mirror on turntable Ferson often uses this on his Draper machine

Dietz further wrote "If afraid of wrist-breaking crank at table level in the Strong drawing, substitute the crank I sketch" This is re-drawn in Figure 3, at *A* Central bolt might enter from beneath and have big wing nut Better than set-screw, weld round eccentric on vertical crankshaft

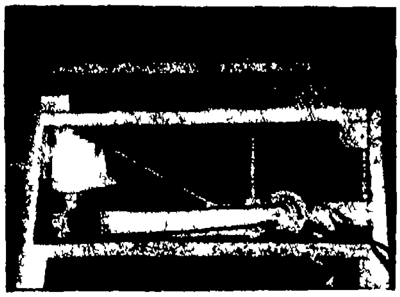
Figure 2: Broadhead's Draper

Sketches in Figure 3 are your scribe's and your groans are excusable Would that Porter were handy A draftsman who himself is a telescope maker and therefore knows what he is drawing, and also is an artist, is a combination devoutly to be desired Many have written and spoken glowingly of Porter's pencil-skilled help to our hobby

Dietz comments, finally "I never used fancy counterweight lever on top but piled lead weights on collar on driving pin" This reminds one of Harold Lower's comment about his simple hogger-outer in "A T M.A," page 410 "Our machine was so damn' simple that fellows who copied it added fancy complications, and then it was out of order half the time" Perhaps Lower overlooked "Yankee ingenuity," that is, never leave simple what can be possibly be complicated

The "adjustable guide" in Figure 1, which permits changing offset of stroke *without stopping* is important If you must stop you will not fully exploit such a feature, which Ritchey regarded as highly valuable This, too, might be complicated but the piece of gas pipe shown, running in a plain open metal or wooden notch, is as good.

In the Draper the stroke is slightly elliptical which, as Broadhead points out, brings the lap to two zones at ends of strokes instead of to same zone at either end This would not be the case if decentering were gained by off-centering mirror on turntable

As it is difficult to avoid high extension of crank pin above bearing at tabletop this shaft should be rugged and a little more than generous Majority of machines made by amateurs have had too light shafts—whippy, some scandalously so The bearing may be made from a common cast-iron, plumb-

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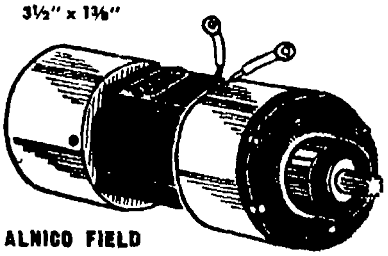

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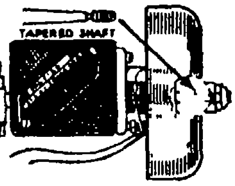

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No scaled blueprints for Figure 1 are to be had Original drawing in Strong's book is twice present scale, also includes detail of turntable shaft, its head and plate But most advanced amateurs own this book or should

One of the best machines your scribe has seen is a modified Draper (Figure 2) built by Dave Broadhead, Wellsville, N Y Frame is a double A-frame, a big saw horse of two-by-fours Length 44", leg spread 36" Height to table top 38" (make it to suit your own legs or high stool) Lower part of legs does not show in illustration Table top is two two-by-sixes

Same illustration shows motor with step pulley, lower right, and long transverse belt (sag helps adhesion if pull is on lower member) At left is a worm gear speed reducer, vertical type, 36 1 (*belts are less satisfactory for high torque at low speeds*) Directly coupled above reducer is a Ford transmission Belt for side drive to turntable has pulley hidden within housing Crank is at top left Arm is a two-by-four ending with ⅜" gas pipe in metal notch

Turntable shaft (full 1¼") has 7/8-14 SAE right hand thread at top and is shouldered Most commercial machines have ¾" 10-pitch National Coarse threads, at least for work up to 10", and spindles which rotate counter clockwise

Arm slides freely up or down around drive pin (Figure 3, *D*), its weight not on tool Additional weights, if used (but see Broadhead's "Moist" technique, this department, 1947, April), are added to top of single weight shown

Figure 3, *E*, shows two simple vertical thrust bearings for shafts Omitted in the sketch is some kind of lateral retainer, otherwise the shaft might some time hop off the ball

End of gear shift handle does not show in Figure 2—bent up for easy reach Transmission gives three speeds and plenty of torque Broadhead says his 1/10 h p motor at 1750 r p m gives 600-pound thrust, in low gear He uses slow speed for more exacting work—getting smooth spheres, figuring Nine speeds permit choices that work out in similar lineal speeds regardless of diameter of mirror

Motor belt cone pulley		Turntable	Arm
1	low	1 2	6
	2nd	2 0	10
	high	4 5	22
2	low	2 0	12
	2nd	4 0	20
	high	7 5	38
3	low	6 0	32
	2nd	8 0	40
	high	13 5	68

A 1/3 h p motor easily handled 31" tools for 36" mirrors on job described here last month Here a separate turntable was used, driven from same crank

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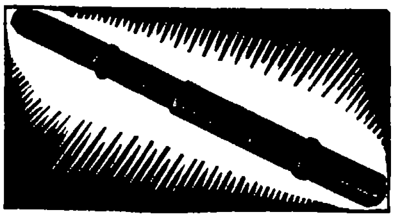

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34 mm Dia	65 mm F L	coated	ea	1 50
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52 mm Dia.	224 mm F L		ea	3 25
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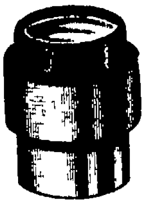

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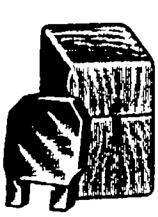

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rotate automatically, is interesting to watch. If the initial contact is poor the lap rotates retrograde from the arm but after a minute or two as contact improves it slows, stops a moment, then reverses, thereafter rotating in the same direction as the arm

Nearly all manufactured machines for use in the optical industry—that is, commercial machines—have free tools but Ritchey insisted strongly on driven tools, writing "the slow rotation of the grinding and polishing tools is rigorously controlled by pulleys and belts" Which, then, is the correct way? Proponents of each argue heatedly but the cynic punching the type mill on which these comments are written suspects that the correct way is largely the one you happen to adopt and get used to using If this is the case, may it not be best to fall back on the principle, when in doubt plump for the lesser complication and resist temptations to exploitation of Yankee ingenuity

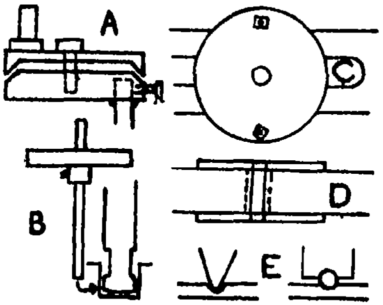

Figure 3: Draper details

Arc stroke machines like "A T.M," page 163, B, are basically Drapers Their "adjustable guide" feature shifts automatically each stroke, spreading the work over two zones The otherwise elliptical stroke is deformed into a kind of bent hot dog shape

Triangular (German) machines like *A*, same figure, are still more versatile Not shown in sketch is adjustable speed drive for secondary arm, also sliding attachment of that arm along main arm Note that secondary arm may be lengthened, shortened Gadget above letter *A* is a bevel gear screw for altering spindle level On this German, Zeiss, or triangular machine the "adjustable guide" shifts automatically but not so often as in the arc-stroke Back geared Ritchey chose to shift this (his "transverse slide") by hand and often, but he usually worked on such big mirrors that this may have seemed to be a better way to distribute the work widely over the zones Anyone who knew Ritchey might be likely to say that, with his meticulous nature, it would have been difficult for him to sit and watch the machine do it all He would have to have a frequent hand in it The transverse slides of his machines were equipped with a screw to perform this function which he did by means of a hand wheel (lathe type) This may have resulted in smoother progression across the zones but, avast!, mention of this may lead some reader into the temptation to substitute a screw and wheel for the simple adjustable slide

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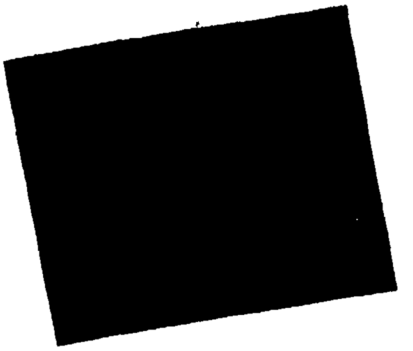

INDUSTRIAL DRAMA: Copper 'cakes ready for shipment from the big mining and smelting plant at Chuquicamata Chile point up the arguments for an adequate copper stockpile in the United States, as put forth by C Donald Dallas in the article starting on page 52

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50 Years Ago in . . .

(Condensed from Issues of August, 1897)

SAFETY IN FLIGHT — "In a critical review of recent progress in aeronautics, Mr Octave Chanute, the well known engineer and promoter of aviation, pointed out a fatal defect in most if not all the attempts that have been made to fly by mechanical means The machines,' he said, 'have almost always come to grief for lack of that stable equipoise which the bird maintains by instinct under the varying conditions of flight and wing Without assured equilibrium safety is uncertain and without a reasonable degree of safety, flight, whether for pleasure or for business, is out of the question' "

X RAY DETECTIVE — The X-rays are winning fresh laurels nearly every day through some new application of their mysterious and irresistible power The most recent of such applications is the utilization of these inquisitive and all-seeing radiations by the custom-house In the railway stations of Paris, the X-rays have been employed for a week past for examining packages of all kinds and sizes, from small parcels and valises up to trunks and large bales, in order that their contents may be ascertained without having to open them The experiments are not confined to baggage, for the travelers themselves are inspected, in order to have the X-rays reveal any objects that may have been concealed under the clothing "

X ray examination of a valise

EAST RIVER BRIDGE —"Work upon the new East River suspension bridge, which is to connect New York and Brooklyn at a point about a mile and a half to the north of the present bridge is now well under way The foundations of the bridge will be four in number, two under each tower, and they will rest upon timber and concrete caissons, sunk by the pneumatic process, upon which piers of solid masonry will rise to a height of 23 feet above high water"

BRICKS AND BUILDINGS — "After the great fire of 1872, the cost of bricks laid in the wall was reckoned in Boston at $36 a thousand Now, better bricks quite as well laid, with better lime and cement, cost there, in the wall, $15 a thousand Fireproofing processes have been greatly improved and cheapened, so that an ordinary mercantile building can be erected, with floors, roof and partitions all of iron and concrete, or terra cotta, for 10 to 15 per cent more than it would cost with cheap wooden floors"

KLONDIKE — 'The announcement of the return of two steamers from the Alaskan gold fields last month with a small party of miners on board who carried about a million and a half in gold between them, has gone through the world like an electric shock and bids fair to end in a 'gold fever' comparable only to the wild excitement of the California discoveries in 1849"

ROAD SAVING — "The United States Department of Agriculture is carrying out experiments with a view to saving country roads from deterioration The device consists in laying down in the center of the road two flat steel tracks to the gage of the average farm wagon They will be bedded in gravel laid in trenches, and they will be tied together at the joints and in the middle"

SUPER INSULATION — 'It has recently been found that liquid air is one of the most perfect insulators, and that most insulating materials cooled to the temperature of liquid air are greatly improved in insulating qualities It is known also that cooling renders it more difficult to cause a spark to occur between oppositely electrified conductors, the striking distance for a given pressure being diminished"—Elihu Thomson

ROAD RACE – 'Under the auspices of the Figaro and the Journal des Sports the race for automobile vehicles between St Germain and Dieppe, a distance of 170 kilometers (105 miles), was run on July 24 The weather was splendid and the roads were in perfect condition As might naturally be expected, the motorcycles arrived first, that of M Jatin reaching Dieppe in 4 h 13 m 33 s The motorcycle of M Pellier arrived 4 43 55 The first horseless carriage to arrive was that of MM De Dion et Bouton, which arrived in 4 h 18 m 34 s"

100 Years Ago in

(Condensed from Issues of August, 1847)

FERTILIZER — 'Sulphuric acid invaluable for many purposes, is coming into common use among the English farmers Crops remove the phosphate of lime from the soil—bones dissolved in sulphuric acid produce the phosphate, and the phosphoric acid so produced has been brought to bear upon the land with the most beneficial effects"

BAROMETER — "An improved Barometer was patented last year which appears to be of some importance It consists simply of a cup with a disk placed over it, air tight, and the air is exhausted from the interior The disk, which is of sheet metal is made waving in concentric circles, and can therefore yield as the pressure of the atmosphere increases and by a very simple device the yielding of the disk operates a hand upon the dial"

WIRE ROPE — "A rope, nearly three miles along, now lies at Gateshead, England, which was the other day a stone in the bowels of the earth' Smelted, the stone yielded iron The iron was converted into wire The wire was brought to the wire-rope manufactory near Gateshead, and there twisted into a line 4,660 yards long It is the stoutest rope of the kind ever made"

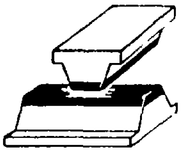
ANCIENT STEEL — The steel of the ancients in consequence of not being cemented, suffered itself to be hammered, and was not near so brittle as the hardest with which we are acquainted at present"

A BILLION ORDERS A DAY

In a large modern telephone office 2 000 000 switch contacts await the orders of your dial to clear a path for your voice. They open and close a billion times a day.

At first, contacts were of platinum—highly resistant to heat and corrosion but costly. Years ago Bell Laboratories scientists began looking elsewhere, explored the contact properties of other precious metals—gold, silver, palladium and their alloys—and with the Western Electric Company, manufacturing unit of the Bell System, restudied shape, size and method of attachment.

Outcome of this long research is a bar-shaped contact welded to the switch and positioned at right angles to its mate. For most applications an inexpensive base is capped with precious metal.



Savings from these contacts help keep down the cost of telephone service. This is but one example of how Bell Laboratories serve the public through your Bell Telephone Company.

An engineer examines contacts in a crossbar office. Horizontal bars seen in the crossbar switches select contacts which are then operated by vertical bars to establish talking paths between subscribers.

BELL TELEPHONE LABORATORIES

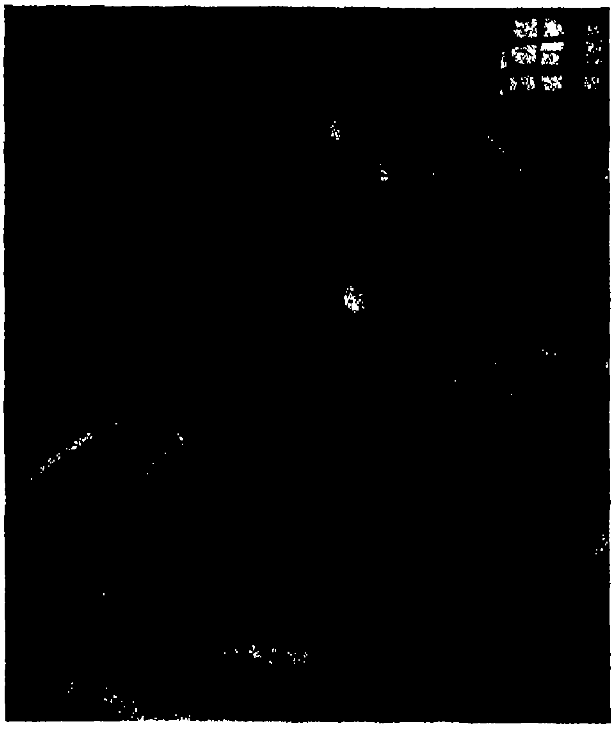
EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Scientific American
AUGUST • 1947

America Needs A MILLION TONS of Copper

An Adequate Stockpile of Copper — in Ingots, Bars, or Other Convenient Shapes — is Essential to All Industry in Peace as Well as in War The Cost of Such a Stockpile Would be Low, It Would Represent an Investment Which Never Would be Wasted At Least a Part of the Stockpile Might be Acquired by Accepting Copper in Payment for Some of Our Nation's Many Loans

By C. Donald Dallas
Chairman of the Board,
Revere Copper and Brass Incorporated



ONE MILLION TONS of copper is a lot of red metal In cold figures it is hard to visualize but if all this metal were concentrated in one cube, the block would contain 3,640,000 cubic feet and would be almost 155 feet on each side Or, in the form of the customary ingots, it would load 20,000 gondolas or a freight train approximately 225 miles long

But one million tons is the amount of copper needed to provide this nation with an adequate stockpile—a reserve of copper that is essential to our national security Such a reserve is as great a defense against potential aggression as is a well-equipped fleet in time of actual war

By a national copper reserve, I do not mean a million tons of copper in the stockyards of the copper fabricators or metal as yet not smelted or unmined The need is for that million tons in ingots, bars, or other convenient shapes, owned by the government and stored at strategic points for use in a national emergency

Today this nation is without a stockpile We had a national copper reserve at the end of the war and the government was still buying copper However, another national emergency arose this spring and the country experienced a copper famine The government reserves were allocated to copper and brass mills Because such reserves were available, factories remained in operation and men kept their jobs until suspension of the copper excise tax by the Congress brought some further relief by permitting foreign copper to flow into this country

Copper is as essential to national defense as steel or rubber or petroleum Planes won't fly, battleships and subs won't sail, radar won't work without copper Brass is required for shell cases, and copper is essential for driving bands on projectiles

Today's great barrier to a stockpile is that there is barely enough copper available now to supply the critical needs of industry Today we are importing copper from Chile because our own mines don't produce enough copper by 600,000 tons to meet our national commercial demands

Obviously, the government is not going to bid against the copper fabricators who are supplying essential copper for automobiles, manufacturing equipment of all sorts, fractional horsepower motors, and all the other things that are needed so badly Instead, as previously mentioned, the government has drained its own reserves to help out industry

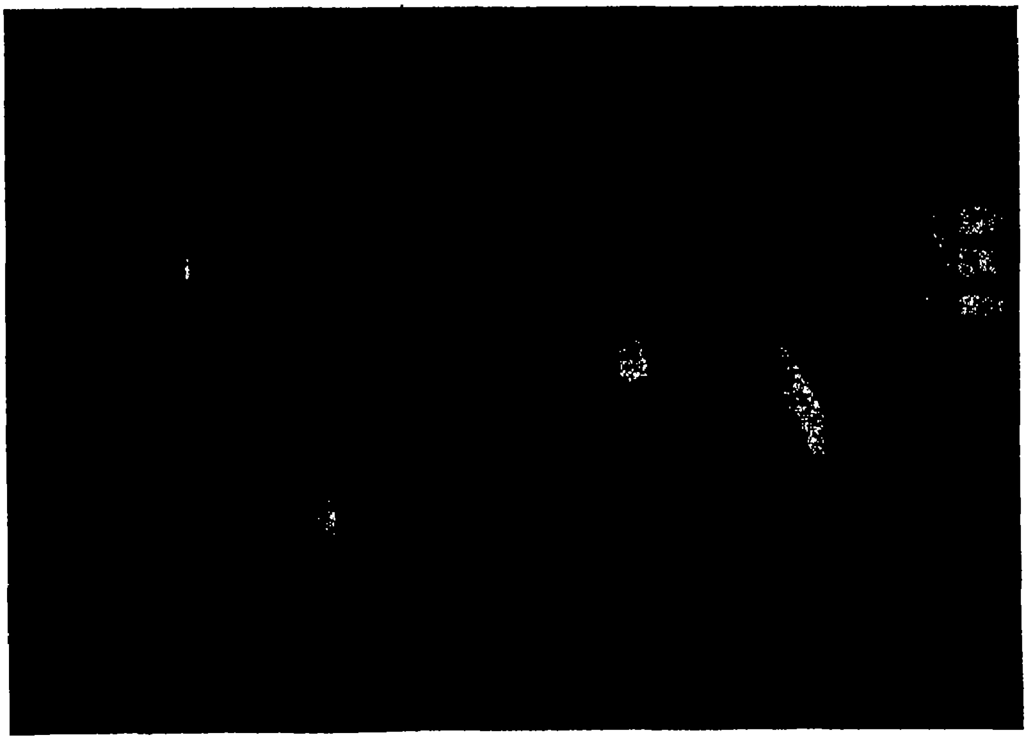
So, the government must wait until the copper supply in this nation is on a more even balance The hope of the copper industry is that that long-delayed balance will be a fact in 1948 But with all the world hungry for copper and with our national consumption of copper at an all-time peace-time high, it is also apparent that that million-ton stockpile won't accumulate overnight

The stockpile law, as now written, provides that the government reserves shall come from domestic mines However, the three major producers of copper, who account for 80 percent of the national production, use almost their entire production in their own fabricating plants A certain amount of reserve copper may come from the submarginal operations. In fact, government purchase of copper may encourage additional development of these submarginal deposits Even so, the United States must look to foreign mines for its essential reserve copper

COPPER FOR LOANS — It is possible that some of our more astute governmental economists will work out a plan whereby we can be repaid some part of our many loans in copper That possibility, so far as I know, has not been discussed in Washington It should be

There is little to indicate that this nation ever again will have a surplus copper production In fact it has been estimated by experts that, at our present rate of production, our unmined known reserves will begin to dwindle rapidly at the end of ten years There may be new discoveries in South America and there may be additional developments in Canada And we have been told that a surplus may develop in the African mines Such additions to world supply, of course, should lower the price of copper and provide the government with an incentive to step in and build up the million-ton reserve as rapidly as is possible

Not only is the national stockpile non-existent at present, but the manufacturing stockpiles of the nation also are still dangerously low The manufacturers, during the copper shortage, had to drain their reserves to keep their mills running In some mills,



At left and right are views taken in the George Keller Copper Works, Brooklyn, New York, one of the largest fabricators of brewery and other processing equipment. Here copper is shaped to required forms in huge sheets and tubes, much of the work being of such a specialized nature that it is done by hand

In a national crisis, would copper jewelry be reconverted into more essential items?

ingots shipped from the smelters were being rolled within a few minutes after they were unloaded from freight cars In normal times such shipments of ingots go into stockpiles and are withdrawn as needed, so that mill operations are not on a hand-to-mouth basis Today we have an entirely abnormal situation Orderly manufacture on an economical and continuous basis, requires an adequate reserve of raw materials as well as a stockpile of finished or semi-finished products This provides an even flow through the channels that run from mill to factory to consumer and makes it possible for the consumer to obtain what he needs with a minimum of delay

If faced with a rush of war orders, the manufacturers may rapidly exhaust their reserves Then is the time that the national stockpile would serve its best purpose Victory has always gone to the force with the largest and best-managed reserves of materials

During 1942, this nation was in an extremely critical position because of lack of rubber reserves If we were brought face to face with a national emergency in the next 12 months, our situation would be even more critical insofar as copper is concerned Instead of combing vacant lots for old tires, we would be calling on American housewives to turn in their lovely old copper bowls and their antique brass candlesticks to be melted down into shell casings and the wire needed for multi-motored fighting planes We would be stripping buildings of their beautiful and everlasting copper roofs, just as Germany did during both World Wars

DESTROYER OF COPPER — War destroys copper Industry at peace uses the same metal over and over Hundreds of thousands of tons of copper were lost forever in battles on land and sea and in the air In peace-time though a machine may be junk, the copper and brass in it may be used again and again The loss of copper and brass through oxidization is relatively minute and is industrially unimportant

We have not yet begun to calculate the complete loss of copper from 1941 until 1945 We are only now feeling its effect But, with a million tons of copper in a national stockpile, with our manufacturers adequately supplied with reserves, and with our mines operating at full capacity, we could feel reasonably secure Until that time arrives, a dangerously weak spot exists in our plan of national defense

Nor is copper the only metal that should be put into a national stockpile Lead and zinc are vital metals and our reserves are low Along with tin government stocks of these metals were channeled into industry this year by the War Assets Administration to relieve shortages Tin has been in short supply and the disaster at Texas City, affecting tin smelting operations as it did, made the situation still more serious It is obvious that adequate metal reserves are essential to peace-time economy as well as to war-time emergencies

Drawing copper wire in a multiple die

People have been known to question the displays of copper and brass ornamental ware and the use of copper and brass in costume jewelry at a time when factories have been threatened with closing because of a shortage of raw materials Actually the amount of copper diverted to costume jewelry or ashtrays is negligible At the same time, the manufacture, distribution, and sale of these articles for which there is a demand supplies work for many people and is essential to our normal economy Possibly, in a real crisis, these articles—some of them best described as hunks of lovely junk—could be reconverted into more essential items However, in a crisis industry needs copper in substantial-sized ingots, ready for the mills, and there is little time to collect and reconvert the purely ornamental into the ruggedly useful Two million tons of copper in the shape of

• LOOKING AHEAD •

Increased dependence on foreign copper sources. Encouragement to develop submarginal deposits. Lower price of copper as new supplies are revealed. "Scrap drives" for copper would not answer in a crisis. More interest in—and action on—vital metal matters.

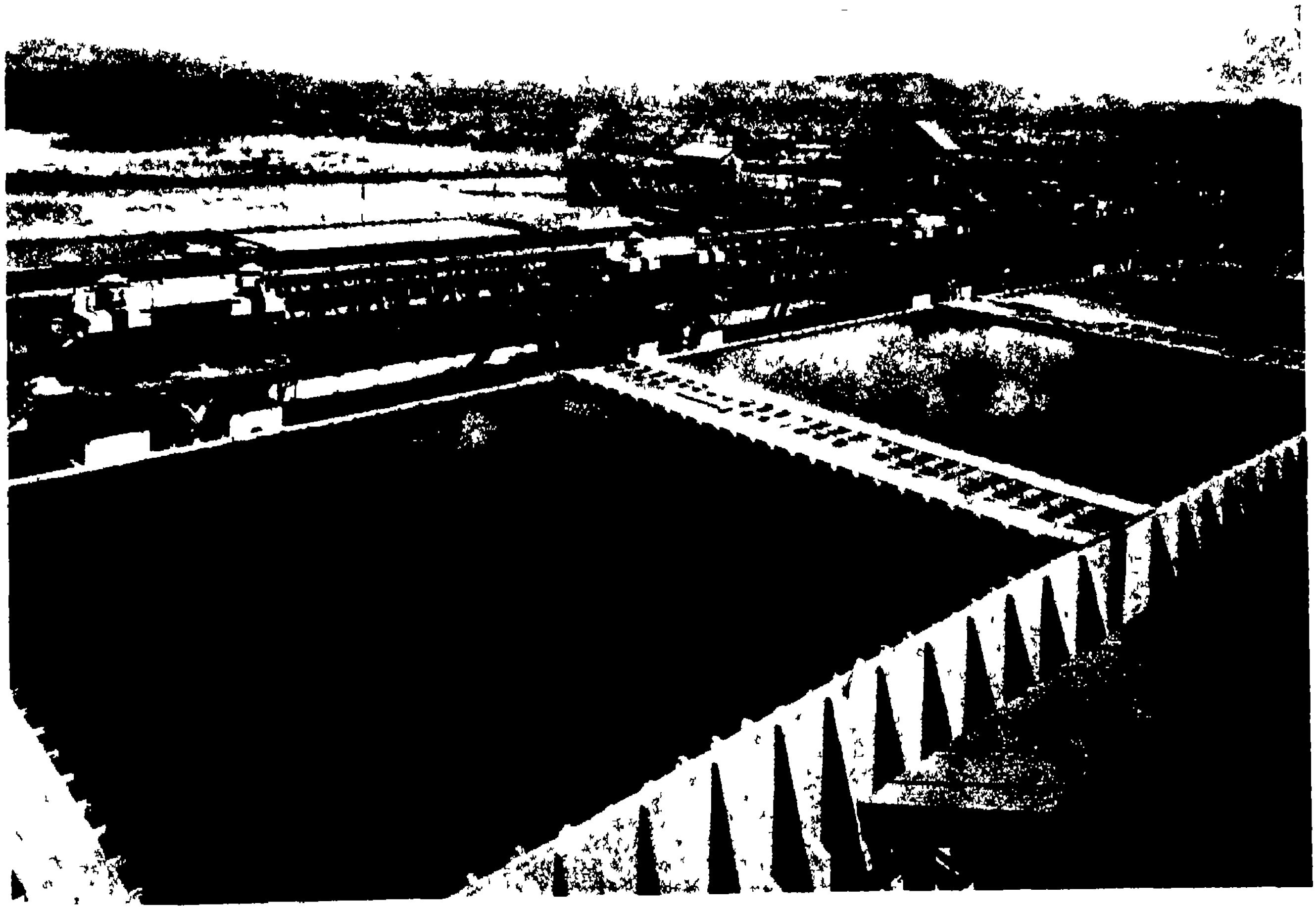
bookends or other metal miscellany and scattered through fifty million American homes would be a poor substitute for those vital million tons placed where they can be put to immediate use.

A STEP FORWARD — This year saw a long step forward in governmental help toward solution of the copper problem. The Congress suspended the $80-a-ton excise tax on raw copper and, for the first time since 1932, American fabricators were free to seek copper wherever they could find it throughout the world to replenish their depleted stocks. Following the suspension of this tax, copper flowed freely wherever it was needed, with the result that foreign copper receded from 24 cents a pound plus a tax of 4 cents, or 28 cents a pound, to 21½ cents a pound. With this tax suspension to relieve a critical situation in industry, Congress may next turn its attention to the national stockpile. During hearings on the Patterson bill, which eventually became the act to suspend the excise tax for two years, a number of Congressmen asked pointed questions about the lack of a national copper reserve and there were indications on Capitol Hill of early action in that direction.

The excise tax suspension is effective until April 1, 1949. If by that time American mines can meet American consumption, it will again be imposed. However, there is little hope in the copper fabricating industry that such a condition will exist and it is highly improbable that American mines will be able to contribute to any great degree to the million-ton stockpile that is an admitted national necessity.

Copper, because of the widespread publicity given the battle in Washington to have the excise tax suspended, received more attention this year than it has had in a generation. American citizens today, I believe, are more cognizant of the importance of copper to their everyday lives than ever before. With this awakened national consciousness of the importance of one of our vital metals, it is possible to predict that we can expect action in the near future on stockpiling those million tons against the time when we will need them—and if that time never comes, the investment will not have been wasted any more than is a battleship that never fires at an enemy, or a life preserver that is never used.

Copper may be recovered from low grade ore by processing in enormous concrete vats



Courtesy Westinghouse Electric Corporation,

The steel cores of these transformers windings are more efficient and compact due to increased knowledge of atomic and crystallographic arrangements

Tomorrow's Metallurgy

While There Are Many Startlingly New and Revolutionary Developments in Metallurgical Sciences Just Over the Horizon, Some of the Most Important Advancements Will Consist Merely of Taking Fuller Advantage of Established Principles

By Fred P. Peters

Editor in Chief, MATERIALS & METHODS

IF THE future can be reasonably predicted from the past, as some say, tomorrow's industrial metallurgy may be forecast by projecting recent technical progress into the years that lie ahead

There is one significant starting point While there have been hundreds of great technical advances in the development and use of industrial metals in the past two decades, they have stemmed largely from a miserly few fundamental scientific advances, most outstanding of which are

(1) New knowledge of the transformations in, and the hardenability of, steel

(2) Successful study and increasing understanding of precipitation-hardening phenomena in non-ferrous alloys

(3) Definition of the mechanism by which metals fail under mechanical stresses

(4) The "science" of mass production of precision parts (their reproducibility, interchangeability, and increasingly closer tolerances—all at low unit costs)

(5) Clarification of flow phenomena in metals as related to their atomic structures or lattices

(6) Discovery of the disproportionately great effects of tiny amounts of impurities, especially gases, in metals

On such foundations as these is the present science of metals based But even today the scientific knowledge that is available is not being put to its fullest possible use To take a single example Despite present fairly accurate and demonstrably useful information on the mechanics and geometry of fatigue failures, how many engineers have studied it, and how many apply these principles to the design of manufactured metal products? It is known that a majority of metal failures occur at surprisingly low stresses, and are due to stress concentrations, especially under repeated or vibrational loading But is every effort made to determine the stress distribution inside a product before, during, and after processing, to surface-finish it, and then to load it in service in such a way as to reduce the likelihood that it will suffer a fatigue failure? By the full application of existing principles, such failures could be held to a minimum until that day arrives when the present exhaustive research bears fruit, and it becomes possible to design quantitatively (and without "factor of safety" support) with complete assurance that failure will not occur

GAPS IN KNOWLEDGE — There are still many blank areas in metallurgical knowledge that ought logically to be filled by now Even now, metallurgists are trying to apply the known laws of atomic physics and diffusion in order to gain understanding of the type of bonding that occurs in powder metallurgy operations, and thereby ultimately to effect significant practical improvements in the processes involved. Other researchers are looking into metal surfaces—studying the relations that exist between the atoms of two highly polished surfaces, investigating the delicate surface phenomena involving lubricating films on metals, and observing closely the friction and other temperature-dependent reactions that occur when one metal rubs against another. In this way a great deal more may be learned about bearings and machining and automobile clutches and brake drums and what happens to stamping dies—indeed about dozens of related situations where today's knowledge and practice are still entirely empirical.

During the past 20 years no industrial process has matched the growth, in engineering importance and use, of heat-treating as a metallurgical unit operation. The nature of all the commercially important micro-structures of steel is known and a satisfactory understanding has been reached as to why and how steel hardens. But one great opportunity for heat-treating progress is still largely unexplored. Application of the principles of heat transfer—the flow of heat through solids, liquids, and gases, and across fluid films—to the heat treatment of steel. Halting steps forward have already been made in improving quenching practice through consideration of the changing rates of heat flow through the metal, through the vapor or liquid film at the interface with the quenching medium, and then through and out of the quench bath—all at different temperatures. But it is possible to get much more out of steels through the study and use of heat-transfer principles than is being done now by simply trying to improve on existing processes.

How else might the scientific knowledge already available be utilized? A tip could be taken from the developers of the Sendzimir rolling mill, or of the new Tube Reducer process, to find out why and how metals under certain conditions can be given astonishing amounts of reduction in forming without suffering anything like the expected amount of work-hardening. Certainly much more should be done with continuous casting—that is, the continuous production of bars, billets, or sheet direct from the molten metal—than has been done so far. Only the aluminum and the copper-alloy manufacturers employ the processes on anything like a large scale. And the wonderful technical advantages of vacuum metallurgy, potentially useful in a dozen major processes, are only just beginning to be exploited.

EXCITING PROBABILITIES — All of these things can be done merely by extending and applying knowledge already at hand. But what about the fields where new knowledge is needed, or where science is just breaking into new areas marked for future conquest? Here is where one must perforce restrain the imagination, for the probabilities *are* exciting. The metallurgical and materials engineering aspects of atomic fission, the development of *really* high-temperature alloys, the discovery (or rather the *design*) of super-strength metallic materials, the implications of supra-conductivity, and the likelihood of metals like titanium and beryllium emerging as commercially-important base-metals—all are bright spots in the picture of our future science of metals.

Radioactive isotopes, produced in neutron reactor piles like those at Oak Ridge, are already finding many uses as tracer elements in metallurgical research, just as they are in medicine and many other branches of science. They are attacking several of the tough research problems previously mentioned. For example, a study of friction and lubrication has been made by introducing radioactive material into one of two metals sliding against each other, and then measuring the amount and location of the metal transferred from the first member into the second.

Again, a major problem confronting the steel industry is a controlled method for removing sulfur

These all aluminum home freezers in production by the Reynolds Metals Company typify the broadening applications to which the light metals are being put

from iron when the iron is separated from the slag Before this can be accomplished, the mechanism by which sulfur is distributed between slag and metal must be understood Researchers are now in a position to study the reaction, since radioactive iron and sulfur atoms can now be introduced into it

Other metallurgical problems that may be successfully studied with the aid of this brand new technique include the absorption of gases in metals, diffusion of the elements in alloys, the thermionic activity of electronic filaments, and so on. One of the most interesting possibilities is the use of certain extremely active radio-isotopes in place of radium for gamma-ray radiography—isotopes which can furnish radiation of a penetrating power comparable to that of the multi-million-volt betatron X-ray machine

An off-shoot of nuclear fission that will be of increasing interest to materials engineers and metallurgists is the need for information on the nuclear properties of materials Determination of the half-lives of radioactive isotopes for calibration purposes and for tracer applications is only part of it Metals used in reactor piles must have definite neutron absorption properties—usually the lower the better Beryllium, for example, is in itself a good moderator because of its very low neutron-absorption proclivity But even tiny amounts of other elements present as impurities in beryllium can absorb so many neutrons as to stop the reaction Hence "neutron absorption properties" will certainly be among the physical characteristics of metals as published in the future

• LOOKING AHEAD •

Titanium and beryllium gaining commercial importance as base metals Radioactive tracers providing solutions to many • problems Neutron absorption properties as important metal characteristics Metals of super strength, lightness, heat-resistance—or nearly any other property—made to order

Heat treatments by induction, such as this hardening of an armature shaft, are expected to be used on a greatly increased scale

Courtesy Eclipse Pioneer Division, Bendix Aviation Corp

The high-temperature alloy developments of recent years have been significant, for the so-called "super-alloys" gave us turbosuperchargers and jet engines But, by and large, they were simple extensions of existing knowledge, often evolved under the terrific pressure of war-time urgency Also, they are good as far as they go, but admittedly they do not go far enough Reaction engines can be operated today at 1500 to 1600 degrees, Fahrenheit, but *really* high efficiency must wait upon materials that can continuously withstand temperatures hundreds of degrees higher Chromium-base alloys, tungsten- or molybdenum-base materials, and metal-ceramic combination are all under study or consideration There are "bugs" that plague all of these, and the final answer to this problem is not yet visible But there will be an answer ultimately and its development will be an interesting chapter in the future "Science of Metals"

REARRANGE ATOMS — Many well-informed scientists today believe that only a minor fraction of the mechanical properties are now being obtained from metallic materials—that metals of the future will be vastly superior Lest this seem too fantastic, remember that up to now (and probably this will be true for many years still to come) metals have been used in the atomic forms and structures in which the Good Lord provided them Who can say that it may not be possible to put atoms together in new ways, to achieve combinations of nuclear or atomic particles hitherto unknown, and which may result in extraordinarily dense or phenomenally strong and cohesive engineering materials?

The new science of metals, too, will include a lot more plain practical common sense mixed in with fundamental science Simulated service testing will replace arbitrary standardized test methods for many purposes where the standard tests are misleading or meaningless Specifications will be considered suspect unless frequently revised, performance will carry a larger burden of importance than chemical composition when materials are selected and specified Such techniques as those of quality control by statistical methods—a science in itself—will be more widely applied to eliminate wasteful and unnecessary inspection, and to improve production efficiency and product quality

Indeed the science of metals of the future will be not only for the research metallurgists in their ivory towers, but will be a living thing understood and used by all who work with metals

It will not be greatly different from the old There will just be more of it—and a whale of a lot more people professionally and vocationally interested in or dependent on it.

Previews of the Industrial Horizon

By A. P. Peck

PROGRESS IS SOMETIMES SLOW

CHEVROLET recently unveiled its first post-war automobile assembly plant. Proudly were shown conveyors which bring chassis to the workmen at bench height so that a minimum of stooping and lifting is required. Paint spraying is done in shielded booths where the fumes are blown by fresh air away from the operators and into a water wash. Headlights are adjusted by photoelectric means.

Viewed from our editorial vantage point (those who disagree with us will call it an ivory tower), it often seems that industry is unnecessarily slow in adopting methods which would result first in worker convenience but would be somewhat tardy in showing up on the profit side of the ledger. Chevrolet simply happens to be a convenient case in point. Why should bench-height convenience for workers only now be coming to the production line? Advantages of water-wash curtains for paint spray booths have been known for years. Photocell methods of headlamp adjustment are at least equally old.

Please let answers not refer to Columbus and the egg; also, please assume relative familiarity with the problem of equipment cost. Industry in general and the automotive industry in particular, has been quick to seize new materials and new methods if they promise immediate profits. But where worker convenience and comfort are concerned there is often a thunderous silence of apathy. Sure enough, the vice-president in charge of worrying about workers may provide clean wash-rooms, may see to it that the plant has the best soft-ball team in the community, may pass out an occasional gold watch for long and faithful service. But does he worry very much about the cricks in the back which comes from unnecessary bending and lifting, about the respirators which must be worn because forced-draft air circulation is not provided, about inaccurate assemblies that are passed because of archaic checking methods but that do not have too much of a day-to-day affect on profits?

Perhaps in these few lines lie some of the reasons for worker unrest, for strikes, for slow-downs. Where such more or less intangibles have been put under humanistic scrutiny which weighs the relative values of ways and means for employers and employees alike, the horizon is bright.

HOW ABOUT GETTING BACK?

PRESENTED without comment:

Dr. J. M. Zucrow, professor of jet propulsion and gas turbines at Purdue University, says that available rocket construction materials and fuels could be developed into a "multi-step" rocket to carry human passengers into space. Such rocket flights could be accomplished, says Dr. Zucrow, without awaiting the advent of atomic power to drive the ships.

E. H. Heinemann, chief engineer of one of the Douglas Aircraft plants says that since rockets operate most efficiently above the earth's atmosphere, the problem of using them for human transportation is complicated by the necessity of re-entering the atmosphere at a speed of several thousand miles an hour and landing safely. Everyday rocket travel, according to Mr. Heinemann, therefore appears to be in the rather distant future.

PREFABRICATED BUILDING MATERIALS

THIS is NOT a paragraph about prefabricated houses. Rather, it is about a movement to standardize—prefabricate, if you will—the materials which go into home construction. A national association of building materials dealers aims to have cinder blocks, bricks lumber, building supplies of all kinds, cut or shaped to standards at mills and factories, thus eliminating much of the tremendous waste of time and materials which now occurs at the building site.

Prefabricated houses, except in emergency and other isolated cases, will probably never fill the nation's practical needs plus esthetic desires for housing, conventional methods of building homes is a national disgrace to our vaunted industrial efficiency. Standardized materials, if really standardized, hold some promise of relief from an intolerable situation.

STRAWS IN THE WIND

INDUSTRIAL MOVIES for training employees, selling goods, promoting public relations, and so on, are doing a fine job, but there are too many producers in the field, casualties among them are high. . . . A practical farm tractor selling for less than $1000, with a full set of accessories—plow, planter, cultivator, and so on—is in production, will be welcomed by large and small farmers alike. . . . As predicted here before, many plastics gadget manufacturers are hitting slumps through ill-advised applications of otherwise useful materials. . . . An authority on the subject states that synthetic gasoline and oil made from natural gas or coal can keep the United States supplied with liquid fuel at a reasonable cost for at least 1000 years. . . . 2,4-D, the selective weed killer that has had so much publicity, appears to be capable of improvement, when mixed with onion juice, for example, its action is speeded tremendously. . . . Plastics floor coverings are invading the linoleum field, offering relative price competition plus high flexibility, immunity to water and cleaning compounds, and "self-polishing" surfaces, Vinylite and Koroseal are two of the synthetic resins being used. . . . Steel leaf and spiral springs for automobiles face serious competition from Torsilastic (rubber in torsion) springs being promoted by Goodrich.

MICROFILM MAGIC

By Paul D. Green

In Addition to Its Better-Known Functions of Compressing Bulky Records Into Minute Spaces, Microfilming Is More Than Paying Its Way by Simplifying, or Completely Eliminating, Many Cumbersome Tasks

The eight small packages of microfilm contain records equivalent to those on all the papers in the two tall stacks

During the war, microfilm served to confound a number of Jap Admirals who prematurely took bows for putting American fighting ships out of action Within a few weeks the same Nip commanders were thinking of committing *hara-kiri* when the supposedly permanently disabled vessels were back in action, as deadly as ever Some indestructible ships were resurrected three and four times, until the enemy officers thought they were seeing double These miraculous revivals were due to one of our most unusual weapons microfilmed plans of every floating unit, stored in the Naval Archives building in Washington, D C, and later, at Pearl Harbor When a vessel was severely damaged, the facts were radioed to headquarters, and by the time the stricken ship limped into port, the new parts had already been pre-fabricated from plans flown to repair stations In one case, the destroyer was unable to proceed to base, so the plans, printed from tiny frames of fire-resisting cellulose acetate, were flown to her in a PBY so emergency repairs could be made at sea

Thus microfilm grew up during the war

No wonder companies developing commercial uses of microfilm—Recordak, a subsidiary of Eastman Kodak Company, and Remington Rand—see a limitless horizon and are reaching out as fast as their production will allow And instead of considering microfilm merely as a space-saver and fire hazard reducer, they are promoting it as a great time and energy saver

Take its recent application by bus companies, for example There are over 200 bus lines operating within the boundaries of the United States Quite often one line does business with as many as 80 others, by carrying passengers part of the way along a route People going from California to Massachusetts, say, buy through tickets from an agent at their starting point He hands them a long strip of coupons for different stop-over and transfer points Drivers pick up the coupons which apply to their part of the trip By the time the passengers reach their destinations, their numerous stubs may be in the offices of a dozen different lines Normally, each bus company has clerks write up a lengthy transcript—a separate one for each other company whose passengers it carried part of the way—listing ticket numbers, where issued, where picked up, rate, and so on Then bills are sent to the individual companies, charging them for the total passenger-mileage, and these bills are accompanied by the original stubs, leaving the charging company nothing but a copy of the transcript

BILLING SIMPLIFIED — Now a group of far-seeing bus companies, with an eye to saving considerable time and manpower, as well as minimizing the chances for error, microfilm the stubs on 100-foot rolls of 16-mm film They take adding machine tapes of the stubs, by companies, make up statements which merely show total charges for the month Then they also photograph both tape and bill All of the originals go forward to the paying bus company, the microfilms remain behind, giving them

• LOOKING AHEAD •

Filing and records-storing given new efficiency Billing simplified and made more accurate Flexible methods adopted by scores of industries to conserve time, labor, and space

miniature, error-proof records of outstanding charges

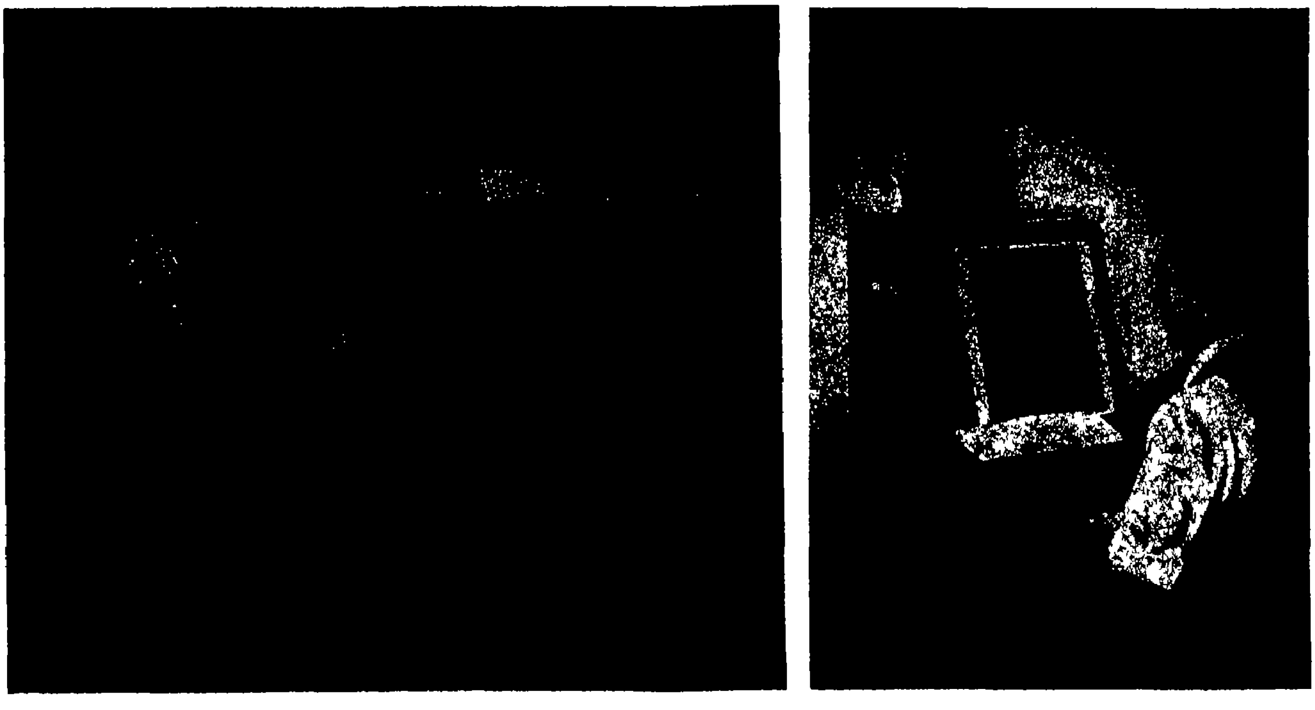
This procedure is a variation of the cycle-billing methods employed by most large department stores in New York and other large cities Before enlisting microfilm to expedite their billing, a store with, say, 350,000 accounts, staggered the load roughly so that statements went out each business day to names beginning with a different letter of the alphabet These statements listed the items charged, as shown on sales tickets retained at the store until paid, a finger-crippling job which demanded tremendous manpower, and yielded a high percentage of error In addition, there was an inevitable flood of complaints on the part of husbands asked to pay for girdles, nylon hose, dresses, fishing poles, and other items they were sure they never ordered Now the stores microfilm each individual sales slip, attach the originals to a simple statement on which is merely listed an adding machine recapitulation of the various charges The painful evidence to the paying papa is included with the statement, and he can readily affirm that the questionable items were signed for by the Missus, his daughter, or son, and act accordingly And the store has copies of each sales slip just in case the statement is mislaid or torn up in a burst of anger Result—hours of labor saved, with a corresponding saving in money, and fewer aspirins for the paying customers

Several retail and wholesale milk companies have adopted similar plans Drivers are given route sheets on which are listed the names of customers served Down each sheet are printed the items left at doorsteps or on store counters—milk, eggs, cream, cheese, and so forth Across the sheets are 31 columns representing the days of the month Each day the drivers mark in the number of items left At the end of the month, they are tallied up, the charges computed, unpaid balances added The route sheets, completely tabulated, are then microfilmed and the originals are given to the drivers for collection, or are mailed to the customers

Airlines and railroads have problems similar to those of the bus companies in carrying passengers who started journeys on other lines Several companies in each group are planning to install microfilm billing systems.

IN FREIGHT HANDLING — Railroads are among the nation's greatest microfilm users, particularly in their freight department—a development which reached great activity with military shipments during the war On any freight movement of length, cars may have to shift from one line's tracks to another's at transfer points, sometimes as often as four or five times a trip, on a coast-to-coast run, this process could involve a dozen switches When the shipment starts, a set of papers is filled out by the shipper at the railroad office, listing all details concerning the load shipper's name, consignee, number of units, contents of units, total weight, rates,

Lower left: At a busy freight terminal, a clerk inserts waybills into a machine which microfilms them at rate of 90 a minute Lower right: Another clerk, with a microfilm frame enlarged on a reader, picks out information for a bill or record of shipment



and so on The original is called the "waybill" and goes with the goods

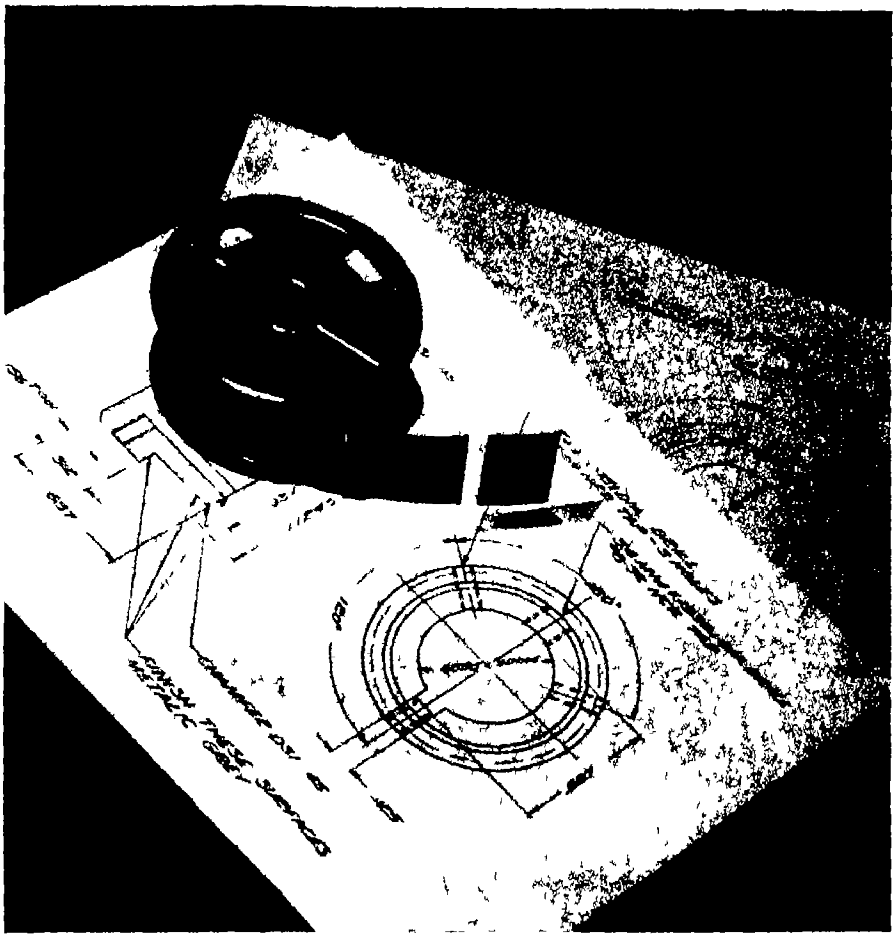
When the long line of cars pulls into a transfer point, they wait at a siding while a clerk copies every single waybill covering merchandise on the train This is the only way the receiving road can obtain records on which to base charges to the original line for the use of its facilities For years this practice resulted in time loss of two or three hours per transfer point, making a total of as many as 24 on a trans-continental trip These long tie-ups often resulted in cars lying in foreign yards beyond midnight, with rental charges of $1 15 per day per car accruing In addition, there is always the likelihood of financial loss to either shipper or receiver through spoilage of merchandise or delay, which results in loss of business to a speedier competitor

Now, over a score of railroads throughout the country have solved this problem with microfilm They have units in each way-station which photograph—60 to 90 a minute instead of 40 an hour copied by hand—each waybill, without error Trainmen can pick up waybills by the time they are ready to pull out of the station With time thus saved at each junction, the cumulative saving to all lines is the equivalent of many thousands of hours a year, which can be translated into making more cars available, an important factor these days when the freight car shortage is admittedly most acute

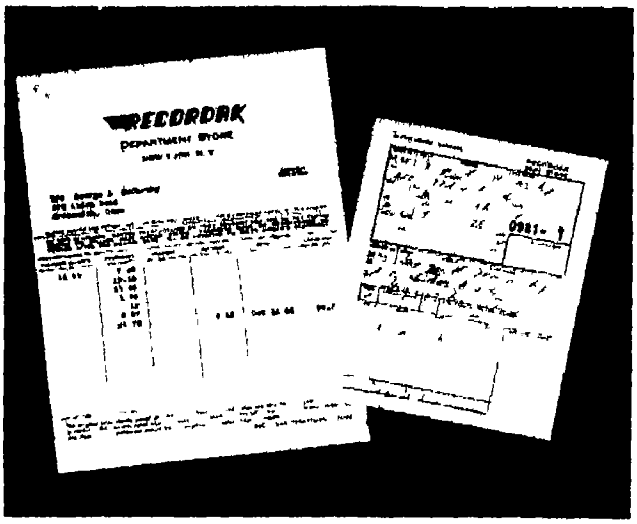
Several wholesale laundries, where thousands of bundles are washed for different independent laundries, have adopted microfilm for billing Since all bundles come to them with only one ticket—the copy of that issued by the store to the customer—that ticket must be returned with the bundle Billing is made once a month by a transcript Now these laundries can microfilm each ticket in duplicate, one going out with their bill, one being retained for their records Industrial insurance companies are considering microfilm also for their agents who collect hundreds of small premiums, from a nickel to a dollar And some chain restaurants and hotels, who must keep guest checks and payroll earnings sheets for anywhere from two to seven years to comply with a multitude of government agency regulations, are considering reducing their warehouses and huge storerooms, now piled high with checks, to filing-cabinet dimensions

BULKY RECORDS REDUCED — Since the war ended, thousands of contractors who performed work for the government were left with uncountable tons of records of their war-time activities One large contractor's records alone fill 77 freight cars, another

A complete office set up for microfilming—film recorder, file equivalent to 160 four drawer cabinets, and reader



How engineering drawings look on microfilm. Such filmed plans helped to keep the Navy's ships in service during the war



RECORDAK
DEPARTMENT STORE

Department stores use microfilm for recording charge account items. A statement, with original sales slips attached, is sent to the customer; the store retains the film

occupies a valuable empty lot, still another fills the entire basement of a huge office building These records must be retained either until final audit—and the Government Accounting Office is usually two years behind—or until renegotiation is completed Some of these contractors have solved their problems, and made room for post-war business, by reducing their files through microfilming to 2 percent of their original size—many four-drawer cabinets are condensed into one

The government, of course, is microfilm's greatest individual user The Social Security division alone has miniature records of 52 million citizens The Treasury has reduced its millions of War Bond stubs to a tidy group of steel cabinets containing 7500 individual records on a single compact 100-foot roll of film City and state governments are also finding microfilm useful The New York Police Department recently recorded the faces of a million members of its Rogues Gallery on microfilm, and the Michigan State Motor Vehicle Department figures it saves thousands of dollars in rental on space saved by its midget records of car registrations

Many states photograph income tax returns to save space At least one state has an arrangement with the district Federal Collector of Internal Revenue to hold income tax returns 48 hours, so they can make microfilm copies and check them against the returns sent in for state taxes It had always been difficult to keep up with the pace in transcribing these returns by hand Now it is done photographically in a matter of hours

Hospitals, too, are prolific users of microfilm, chiefly to reduce their case histories to handy, permanent status Only recently, the Remington Rand Company was called on by the Johns Hopkins Hospital to reduce nearly 8000 90-foot rolls, four inches wide, of cardiograms These long rolls are studied by doctors to help diagnose certain types of cases Now, reduced to 1/23 their length on microfilm, they are a mere four feet long and roll up into a tiny spool

All of which sounds like a lot of heavy loads being carried on such tiny frames, but the photographic frames are strong enough to bear the burden

Courtesy General Electric Company

Vacuum tubes on the control panel at right assure constant temperatures in these metal-melting furnaces, in spite of varying operating conditions

Monitors for Molten Metals

Installed for a Wide Variety of Applications Throughout the Entire Metals Industry, Electronic Controlling and Measuring Devices Have Gone Far Toward Removing the Variable Human Factor From Many Production Processes

By *John Markus*
Associate Editor, ELECTRONICS

WHEN THE stream of molten steel from the ladle in a mill is too hot to look at, yet just the right temperature for pouring, electronic tubes can be responsible for making that melt just right. Man's senses of sight and feeling are saturated by the extremes of brightness and heat given off by white-hot metals, yet precise control is just as important here as for such subsequent steps as electronic heating for forging. Plain electrical controls have served in mills to supplement human senses after a fashion for years, but they have so many drawbacks that electronics is fast taking over for this hottest job of them all.

Vacuum tubes have a host of other jobs, too, in steel mills, foundries, and die-casting plants. At the blast furnace they can indicate stock line inside the furnace, monitor stock line levels, measure system bed thickness, and control skip hoists. At the open-hearth furnace, they can measure flame radiation, tell how much smoke is going up the chimney, and do a host of critical recording jobs. At the Bessemer converter they can indicate the precise instant for the end of the flow and check other flame characteristics that control the quality of the melt. Analysis of the end products, split-second timing of operations, and automatic control of equipment for processing finished blooms, castings, or sheets are just a few of the many jobs that can be done better and more economically by electronics. Representative case histories of a few successful applications will illustrate how vacuum tubes are taking over in the metals industry to keep production costs down despite climbing man-hour costs.

OPEN-HEARTH EFFICIENCY — In an open-hearth steel furnace, transfer of heat from the flame to the charge depends largely upon radiation. This is especially true after the charge has melted, when it lies flat on the hearth, the flames sweeping above it. It is for this reason that measurements of flame radiation are made to assure maximum operating efficiency of open-hearth steel furnaces.

A portable battery-operated radiation-measuring instrument using electronic circuits has recently been developed to provide quick checks of firing conditions at the many furnaces in a large mill. Technically, this instrument consists of a highly stable bridge-type battery-operated vacuum-tube volt-

• LOOKING AHEAD •

Greater knowledge of furnace behavior gained from new instruments measuring temperature and heat radiation. . . . Improved furnace design and operating techniques resulting from this information. . . . Higher quality steels consistently produced with melt temperatures accurately controlled. . . . More uniform die castings.

meter connected to a radiation pyrometer that can be aimed at any desired portion of the 4000 degree flame.

To take a reading, the instrument is placed at a furnace door so that lugs on the heat screen engage the socket hole. This centers the radiation pyrometer in the aperture and assures an unobstructed view of the flame. Because of the rapid response of radiation pyrometers, a reading is obtained in a few seconds. The pyrometer can be aimed by means of the frame and sighted over quite an angle in the furnace.

The readings are left in arbitrary scale values since it is not intended to find furnace temperature, but to obtain comparative data on the radiating power of the flames. The results are affected by radiation from the furnace walls and the bath, as well as by the flame, and this must be borne in mind when evaluating the readings. They are of comparative significance only in revealing efficiency of combustion.

It thus becomes possible with this type of instrument, to obtain quickly a relative measure of furnace efficiency, *free from the errors of human judgment*. By successively making changes in furnace control settings and taking readings of flame radiation, it is possible to find the best control settings and thus achieve higher average furnace efficiencies. One man can check five or six furnaces with the instrument in less than an hour. Built in the electrical department of John A. Roebling's Sons Company, this instrument is intended for use by combustion technicians to diagnose furnace troubles, and as a measuring tool to help them set up standard furnace adjustments.

MOLTEN STEEL THERMOMETER — An electronic instrument which determines and records the temperature of molten steel in the open hearth is widely used on ten steel furnaces in the Ford River Rouge plant. This device enables the operators to determine the steel temperature prior to tapping, thus giving them an opportunity to make any required adjustments, so as to pour at the proper temperature.

This straight-forward method of open hearth control is contrasted to determining the steel temperature by means of an optical pyrometer during the pouring operation, when it is too late to correct the bath. Each heat is tagged with quality control data, including the molten steel temperature, so that it is possible to study the effects of open-hearth operation on the steel all the way from the ingot to the finished product.

The new immersion thermocouple used here can actually be inserted in the molten steel without melting. It consists essentially of an inner and outer condulet, a heavy graphite extension rod for protection

Courtesy Cannon Electric Equipment Company

Use of an electronic timer on this die casting machine to regulate cooling periods greatly reduces the number of rejects at the slag layer, a half-inch diameter fused silica protecting tube, and a 30-inch thermocouple with double-bore sillimanite insulation. A secondary tube, of extra heavy pipe two inches in diameter, surrounds that part of the handle that is exposed to intense furnace temperatures. The annular space between the extension handle and secondary tube is insulated with rock wool to prevent possible warping as well as overheating of the extension leads which go to the electronic recorder.

BESSEMER FLAME WATCHER — Investigation of the luminous energy content of the flame of a Bessemer converter has shown that the quality of the steel produced bears a direct relation to the history of the flame. At the plant of the Jones and Laughlin steel Corporation a phototube is used in controlling the operation of the converter.

The phototube is located about 60 feet from the converter and is so arranged that light from other sources does not affect its operation. Suitable filters are used to emphasize those characteristics of the flame which are most important to the characteristics of the steel being produced. The maximum phototube response obtained corresponds to the temperature of the molten metal, and gives an indication of the nitrogen content of the steel. Near the end of the blow, the intensity of the flame dies down, and the point where this occurs is referred to as the end point because it indicates when the blow should be turned down.

IN DIE CASTING — While the die-casting process has been in use more than a quarter of a century, only in recent years has electronic-type instrumentation been used to control the temperatures of the furnaces and melting pots incorporated in die-casting machines. Now hydraulically operated machines with push-button control automatically make castings five or six times a minute, in weights up to 25 pounds.

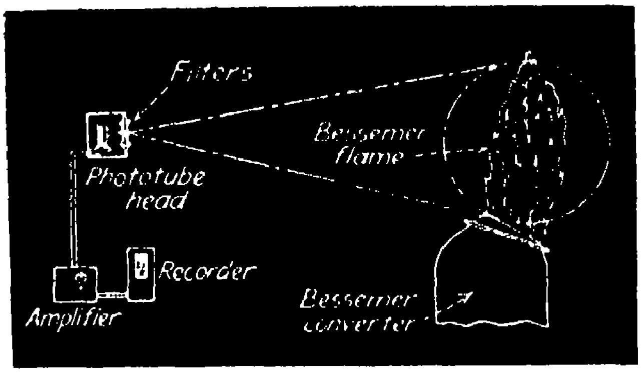
The problem of controlling temperatures of die-casting furnaces is not so much that of extreme accuracy, as of high dependability. Some die-casting alloys permit a temperature range of as much as 25 degrees, Fahrenheit.

The standard electronic controller for many die-casting plants combines the principles of the bimetallic thermostatic strip with those of an electronic capacitance-responsive control. Changes in temperature cause the strip to bend, moving the capacitor plates farther apart and thereby causing the electronic circuit to initiate the required correction in furnace temperature.

Breakdown at the furnace end of a non-controlled die casting machine may cause loss of production due to down-time, or damage to equipment far in excess of the cost of a pyrometric controller.

Another aid to efficiency in die casting of aluminum and zinc is in use at Cannon Electric Equipment Company. Here an electronic timer determines the correct interval between the shot or molding action and the ejection of the casting from the mold.

Before the installation of an electronic timing unit the time lapse for cooling or setting up of the metal in the mold was controlled arbitrarily by each operator. The normal human variation of an operator's timing of the die-casting process often resulted in a warped or otherwise imperfect casting. If the operator were on piece-work, he would frequently develop a tendency to open his machine as quickly as possible after each shot. On the other hand, if the operator were fatigued, or his sense of timing slow, he might allow excessive time to elapse before he opened the mold and ejected the casting.



Set-up of photoelectric monitor for flame of Bessemer converter

Tests proved that this interval was a critical constant for a given type of mold. Any significant decrease in the arbitrary interval value (reduction of 0.1 second or more) resulted in a plastic deformation. Greater tendency for cold-flow warping during machining was also evident.

With the electronic timing unit installed on a die-casting machine, the operator closes the die-cast mold and pours molten metal from a ladle into the machine. He then steps on the foot pedal to ram the molten metal into the mold at high pressure and at the same time close the initiating relay on the electronic timer, starting the timing cycle of from 0 to 18 seconds, as required by the shop foreman. When the time runs out, the tubes actuate a relay which in turn operates a heavy solenoid that actuates an hydraulic valve. This valve opens the die-casting machine. When the machine begins to open, the operator takes his foot off the pedal, pulling the ram back. This also disconnects the coil of the initiating relay, allowing the timer to reset for the next casting.

Since the die-casting machines turn out a variety of products, each machine requires its own timing control unit, and 25 timing units are installed in the plant. These are assembled in one central rack and fed from a common power supply. The removal of one unit does not interfere with the operation of the others. When a new mold is set up in one of the machines the foreman determines the mold curing time and sets the corresponding timing unit. The operator of the die-casting machine closes the die manually, pours the charge of metal, and kicks the foot switch. From that point, the electronic gear takes over.

So the trend goes—to more-than-human electronic measuring and control equipment in the toughest mill locations imaginable, where fumes and heat combine with the hard knocks of heavy industry to provide a real operating challenge for delicate tubes. Yet the tubes are taking it, to prove that properly installed and maintained electronic controls can mean the difference between red ink and black on year-end statements wherever molten metal flows.

Casting Is Changing

New Operating Techniques Applied to the Ancient Practice of Casting Are Resulting in Products Which Come From Molds With Qualities Obtainable Otherwise Only by Wroughting

By Edwin Laird Cady

An experimenter mounted a mold in such position that either vacuum or gas pressure could be applied to nearly all surfaces of it. The only area excepted was the down-gate—the opening through which molten metal would be poured to make a casting.

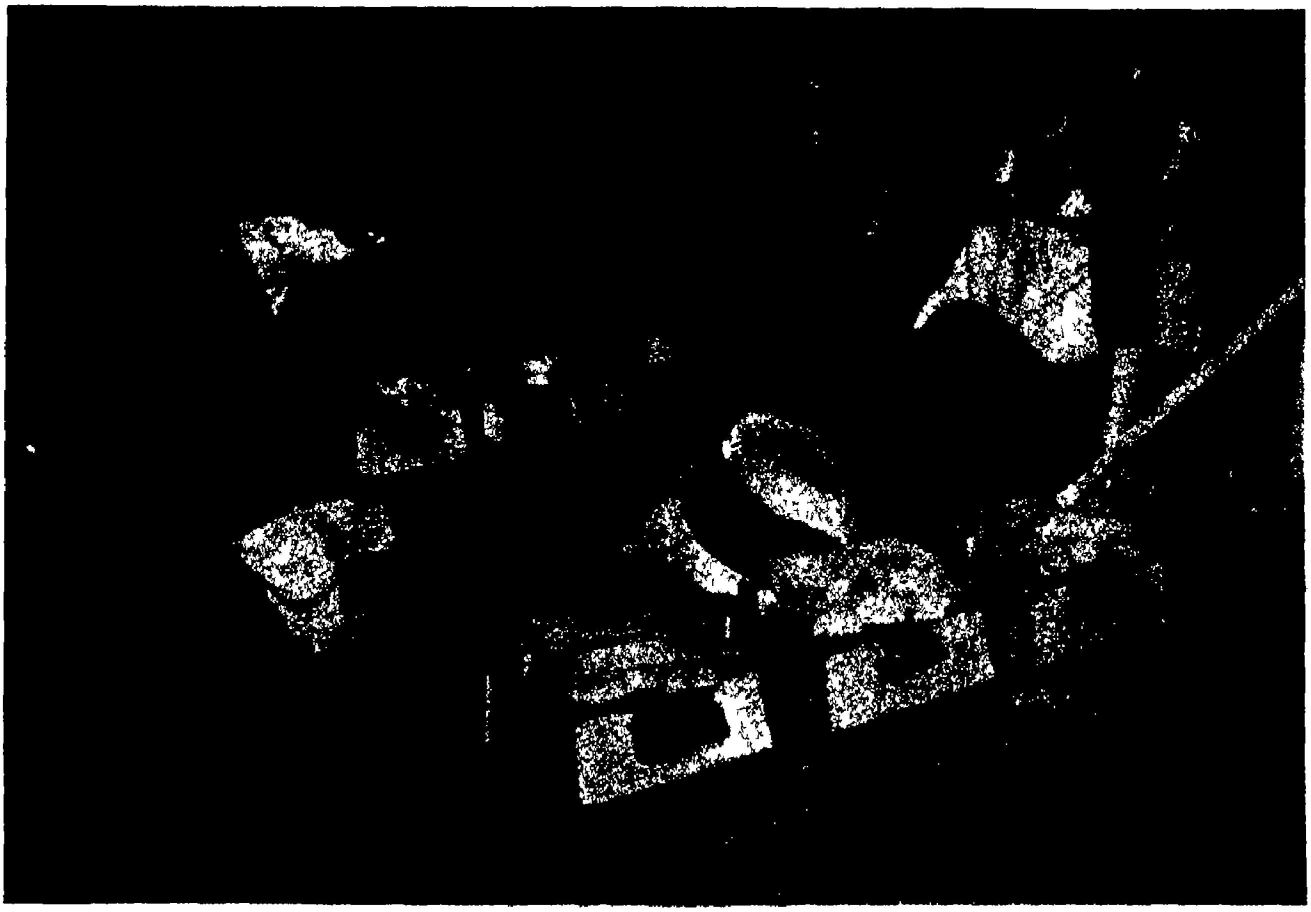
Metal for the casting was melted in a completely closed induction furnace, with an inert gas over the melt. There could be no oxidation, no pick up of hydrogen by this metal.

The mouth of the furnace was brought to the opening of the mold. Vacuum was applied to exhaust the air from the mold in order to prevent oxidizing the casting as it was poured. Then the pressure was reversed. Inert gas was forced in through the pores of the mold. Only minute traces of oxygen could get at the hot metal as it was cast. The furnace mouth was blocking the down-gate of the mold so that no air could enter there.

Sprue and runner passages through which the hot metal must pass had been made to exactly calculated sizes. The gates through which the metal from the runners would flow into the casting cavities had been proportioned with micrometric accuracy. This casting was to be made under conditions of exact control.

"Casting, which is the oldest of the metal working arts, is coming on to become one of the newest"

Courtesy The Austin Company, Engineers and Builders



Metal from the furnace was admitted to the mold The metal was under pressure—about 20 pounds per square inch

That metal flowed rapidly to the gates at the cavities But there it stopped for a second or so The sizes and shapes of those gates, and the pressures of the gas within those cavities, had been calculated so that the metal would be blocked right at the gates

After a pause too short to allow the metal to cool, the vacuum was turned on again This process exhausted the inert gas from the cavities, and allowed the molten metal to enter But the entrance of the metal could be no faster than evacuation of the gas permitted There was a steady flow of molten metal with 20 pounds of pressure behind it, and a steady cushion of inert gas which permitted the metal to advance only at a slow pace The vacuum was carefully controlled to keep this balance just as it was wanted.

This experiment was not being performed just to see what would happen It was one of the final proof tests of a casting method which soon will be in full production In fact, it was one more stride toward the realization of the ages-old dream of making castings which have all the qualities of wrought-metal products.

CASTING TROUBLES — The casting process has troubles Molten metal entering the casting cavities in the molds ordinarily comes into contact with air Oxides then form, mostly on the surfaces of the castings, but also they are likely to be distributed through the metal Other damaging materials, such as hydrogen gas, may enter the melt Sand and other impurities may be picked up from the mold walls

The metal does not always solidify uniformly Rather, some elements or chemical combinations of elements will solidify at higher temperatures than others and therefore will become solid while the others still are liquid These high-temperature solidifying elements tend to deposit wherever the cooling conditions are best and therefore to segregate rather than to distribute themselves uniformly throughout the casting

As the metal cools, it shrinks But the shrinkage occurs more rapidly at the areas which cool first, and this sets up strains as the various areas pull against each other

Wroughting corrects many of these casting troubles The badly oxidized skins can be cut away before the wroughting operations begin. Rolling, which ordinarily is the first of the wroughting procedures, can weld shut many of the microscopic porosities which result from shrinkage Rolling also tends to break up the interior oxides and to distribute them as such tiny islands that they have no weakening effects The same process can distribute the segregated areas throughout the metal and bring much higher uniformity

With many alloys, the greater the number of wroughting operations, the greater the improvement Cold rolling as well as hot rolling, drawing through dies, cold forging or hot forging, all have beneficial effects And altogether, casting followed by wroughting is the ideal solution of many a metal-working problem

The trouble is that wroughting has economic problems One of these is the fact that only rarely can wroughting be done at commercial costs unless applied to large quantities of metal If hundreds or even thousands of tons are not wanted in a low alloy, and

The modern foundry is operated by strict metallurgical control

• LOOKING AHEAD •

Items of hard-to-wrought alloys, or with complex shapes, produced with wrought-metal strengths, without wrought-metal costs Weaknesses in light-metal castings due to gas-formed porosities greatly reduced Range of metals in wrought condition available to fabricators vastly extended Heat-treating while casting

if dozens of tons are not wanted in a high alloy, all to be rolled to a few sizes and shapes, then the wroughting processes are likely to be avoided This tends to limit the ranges of alloys which the fabricator can have in the wrought condition

Wrought metals also have fabricating problems If the shape of the finished product be highly complex, the costs to machine or to stamp or to weld can be high

Worst of all, many alloys do not lend themselves to wroughting Some of these, like the Stellites and other cobalt alloys, and the tungsten alloys, are too hard Others, when worked tend to harden, to become brittle, or to tear

Let casting solve its problems, and the field for wroughting becomes much simpler Alloys can be blended in any desired quantities, complex shapes can be cast at low cost and with very few machining or other fabricating operations needed to complete them, wroughting problems can be eliminated

The drive to solve casting problems, then, is intense And it is leading to some unexpected developments

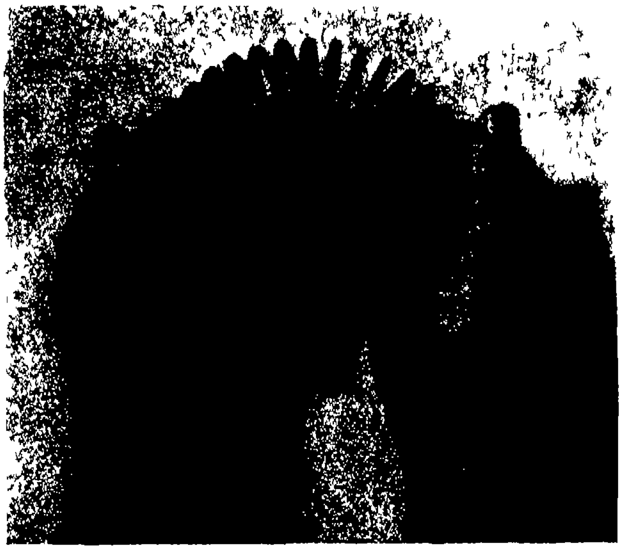
MOLDS ARE CHILLED—In one shop, molds are completely finished and set up for pouring, then are packed in dry ice over night This chills them to 50 degrees below zero, Fahrenheit Aluminums and other light metals are cast into these molds

The light metals have a trouble which wroughting cannot cure They pick up hydrogen while being cast by ordinary methods The hydrogen causes porosities which wroughting does not heal

Ordinary casting cannot prevent this because the metals are too high in thermal conductivities Rather than cooling at some areas first and then progressively depositing solidified metals on those areas, thus progressively squeezing the gas from the solidified portions into the still molten areas and so getting rid of it, the molten portions tend to transmit their heat until the entire mass cools enough to freeze Thus the gas is imprisoned until very nearly simultaneous solidification locks it in permanently But by chilling the molds, the cooling effect upon the outer portions of the castings may be made great enough so that these portions will solidify in spite of the heat conducted to them The gas then is squeezed out

Castings made in this way can be 100 percent stronger than wrought products of the same alloys.

Heat treatment also is being done within casting molds The grain structure, and therefore the strengths and other physical properties of an alloy, can depend upon the length of time during which the alloy is held at a critical or other pre-selected temperature



Courtesy Cooper-Bessemer Corporation

Cast metals can be highly flexible, as evidenced by this spring, cut from a cylindrical casting of Meehanite metal, an improved form of cast iron

By usual practice a metal product is cast, after which it is either wrought or machined or otherwise fabricated Then it is heat-treated for strength, after which it must have further corrective operations to restore its accuracy and improve its surface But by heating the casting mold to the heat-treating temperature, and letting the casting solidify at that temperature, it often is possible to obtain better grain structures and greater strengths than can be had by any subsequent heat treatments

SPECIAL CASTING ALLOYS — The development of special alloys intended to be cast is another modern technique Very slight modifications, such as the addition of a few parts of nickel, can make alloys behave better in almost any mold Stainless steels can be made far more corrosion-resistant if their carbon contents are kept very low Rather than having the traditional "cast brittleness," cast metals can be highly flexible if cast of special Meehanite alloys

All of these techniques have made major changes in casting practices Instead of being a place of dirt and fumes where the foundryman worked by his experience and craft alone, the modern foundry is operated by strict metallurgical control

It is not common to set up with vacuum and with inert gases under pressure to control every movement of the molten metal But temperature control and control of pressures upon the metal are constantly increasing in use

The very shrink forces which have been the enemies of casting are being put to work Non-crushing cores are placed where high accuracies of cast holes are wanted The molten metal shrinks around them, compacts itself, holds to accuracies as close as those obtained by ordinary grinding

No one at this time knows where all of these new techniques will lead. Only one point is certain. Casting, which is the oldest of the metal working arts, is coming on to become one of the newest.

NIGHT COOLING
for
DAY COMFORT

By L. F. Peterson
echanical Engineer, Ilg Electric Ventilating Company

Power Fans and Ventilators, Replacing With Cool Night Air the Heat Accumulated in a Building During the Day, Can Provide Comfortable Indoor Air Temperatures Which Would Be Obtainable Otherwise Only Through the Installation of Vastly More Expensive Equipment

A WAX PAPER manufacturer was encountering heavy losses due to spoilage in his warehouse during the hot summer months The wax softened, sheets stuck together, causing damage in inventory, rejections from customers, and loss of good will An estimate on mechanical refrigeration for the storage space ran well over $40,000, with correspondingly high operating and maintenance costs A survey was made with night-cooling in mind as a possible solution It was found that (1) the paper was stacked with ample space for air to circulate between the rolls, (2) the building design permitted inflow of air near the floor level through doors on either side of the warehouse, (3) a skylight extending the length of the warehouse made possible the inexpensive installation of fans

Hot daytime air, expelled by fans, is replaced by cool, fresh night air entering through windows

All illustrations courtesy Ilg Electric Ventilating Company

The warm air drawn off through the inconspicuous grill (arrow) in the ceiling of this doctor's reception room, is exhausted by roof fans

With such evidence in its favor, a night-cooling system was installed And in this installation, costing approximately $3000, that company found the solution to its problem

This is just a single example of how effective air cooling can be provided at low cost with a night-cooling system

The extremely high air temperatures often attained in buildings during the summer are due largely to the fact that the heat of day is absorbed by the structure itself, and by all that it contains Then, after the day shift has ended and the plant is closed up, the day-time heat is retained inside the building As a result, on the following morning the workers come into a hot, humid, heavy atmosphere that is little better than the peak of the previous day

BASIC PRINCIPLE — Outdoors, however, when the sun goes down, even during extreme heat waves, the temperature drops 10 to 30 degrees And the basic principle of a night-cooling system lies in taking full advantage of this sharp drop in outdoor temperature

Propeller fans or power roof ventilators are installed in walls, windows, skylights, or on the roof Actuated by either electric time clocks or maintenance crews, the fans are turned on as soon as the outdoor temperature has lowered and are stopped in early morning hours The heat which accumulated in the building during the day, along with the humidity, odors, dust, steam, and other unwanted air contaminants, are driven out of the building as the cool night air is drawn in from outside Inside temperature may thus be lowered as much as 20 degrees, the atmosphere is then fresh and inviting when the day shift comes to work

In the case of the wax paper warehouse, fans actuated by time clocks were turned on near midnight to pull cool night air into the building and circulate it around the stored rolls of paper A complete change of air was produced every four minutes The fans were automatically stopped in the early morning, at which time the night watchman closed all windows and doors And care was taken during the day to see that the warehouse was closed as much as possible to retain the low-temperature air Thus, the spoilage of wax paper due to heat was completely eliminated

IN ATTICS FIRST — Starting back in 1918, when our company first adapted the exhaust fan to remove heat from attics, this method of cooling buildings has gained increasing acceptance, and today night-cooling systems are being installed in apartments, hotels, stores, industrial plants, and office buildings

A typical commercial installations is the one made in a group of medical buildings where five buildings contain 170 rooms to be ventilated Into waiting rooms, doctors' offices, operating rooms, X-ray rooms, laboratories, darkrooms, and rest rooms, it is necessary to introduce fresh air, at the same time exhausting stale air, heat, and odors without "short-circuiting" the air, or transferring odors from one room to another Power roof ventilators installed on each of the five buildings are started each night by maintenance crews, and are turned off near dawn Again at noon, the fans are turned on to draw out accumulated heat, and, on excessively hot days, the fans run all day

The result of this installation is a seeming impossibility—complete satisfaction of the 40 doctors who occupy the buildings, with comfortable air temperatures maintained throughout the entire year

In almost any building—industrial, commercial, or residential—where accumulated heat is a problem, the judicious placement and operation of power fans or ventilators will provide air conditions which would cost many times more to achieve with any other cooling technique

FUELS OF THE FUTURE:

For Gas Turbines and Jet Propulsion

By Philetus H. Holt
Assistant Director, Research Division, Esso Laboratories

Editor's Note: *The accompanying article is the second of four, adapted by permission from papers presented at a recent Standard Oil Development Company seminar on Fuels of the Future Each paper deals with different phases of fuels for engines of types now in use, under development, or projected Together they summarize the general subject and furnish a glimpse of the fuels and engines which technology will be offering to transportation in the years to come*

THE PRINCIPLE of the combustion gas turbine which has made possible the development of turbo-jet and turbo-prop-jet engines for aircraft, and which appears also to have a definite place in the future of marine and railroad locomotive propulsion, is by no means new History is full of attempts to develop a satisfactory gas turbine Early experimenters, handicapped both by lack of knowledge which would permit design of efficient compressors and turbines, and by lack of the proper materials of construction, were unsuccessful However, the war-time need for greater and greater speed in aircraft prompted intensive research in these fields, and the increased knowledge of aerodynamics, coupled with the discovery of structural materials suitable for extremely high temperatures, made possible the development of the gas turbine, in the form of the turbo-jet engine, for aircraft. This new type of engine has opened new horizons for aircraft performance, and is one of the outstanding developments since the original flight of heavier-than-air machines.

Basically, the design of the combustion gas turbine is simple There is only one major moving part, a rotating shaft on which is mounted an air compressor and a turbine rotor The compressor supplies air to the combustion chambers where fuel is burned continuously to increase the energy content of the compressed air by heating it The resulting hot gases are then expanded through a turbine, causing the turbine rotor and shaft to revolve In the case of the turbo-jet engine, only sufficient energy is recovered by the turbine to drive the compressor, the hot gases leaving the turbine are exhausted through nozzles to form the jet

In the prop-jet engine, or in a gas turbine constructed for marine propulsion, the greater part of the energy available in the hot gases from the combustion chamber is recovered by the turbine, and the power thus available, over and above that required to drive the compressor, may be utilized to drive an air screw, in the case of high-speed aircraft, or a generator, for example, in a marine installation The prop-jet aviation engine, of course, may still be considered a jet-propulsion unit

The amounts of fuel and air consumed by the gas-turbine engine in developing its power are astounding when first considered A turbo-jet engine developing 4000 pounds thrust, equivalent to 4000 horsepower at 375 miles per hour, will require more than four million cubic feet of air in an hour At this rate all the air in a typical six-room house would be exhausted in about nine seconds Approximately 20 barrels of fuel are burned each hour—enough fuel, if it were gasoline, to drive an automobile 12,000 miles at a speed of 60 miles per hour, or, if heating oil, enough to heat a typical six-room house for two thirds of a heating season

Heat is released in the combustion chambers of the turbo-jet engine at the rate of about 20,000,000 Btu per hour per cubic foot of combustion zone, which may be compared with a rate of one million to two million Btu per hour per cubic foot in the case of industrial furnaces And this great development of power is accomplished with a freedom from vibration unknown in reciprocating engines

BRIGHT FUTURE — The future of gas-turbine power plants for aviation is very bright The turbo-jet engine right now far surpasses the conventional reciprocating engine where extremely high speed is necessary, and where fuel economy is of secondary importance, as in fighters, interceptors, and fast attack bombers at present altitudes When pressurized cabins for very high altitude are developed, it has future possibilities for fast, long range commercial transport There are two reasons First, at altitudes of 40,000 feet or higher the turbo-jet unit is much more economical of fuel than at low altitudes Second, long flights of 3000 miles, which presently take 12 to 14 hours, may be made in six to seven hours, thereby doubling the utilization of equipment and flight personnel, and also providing a more attractive passenger schedule

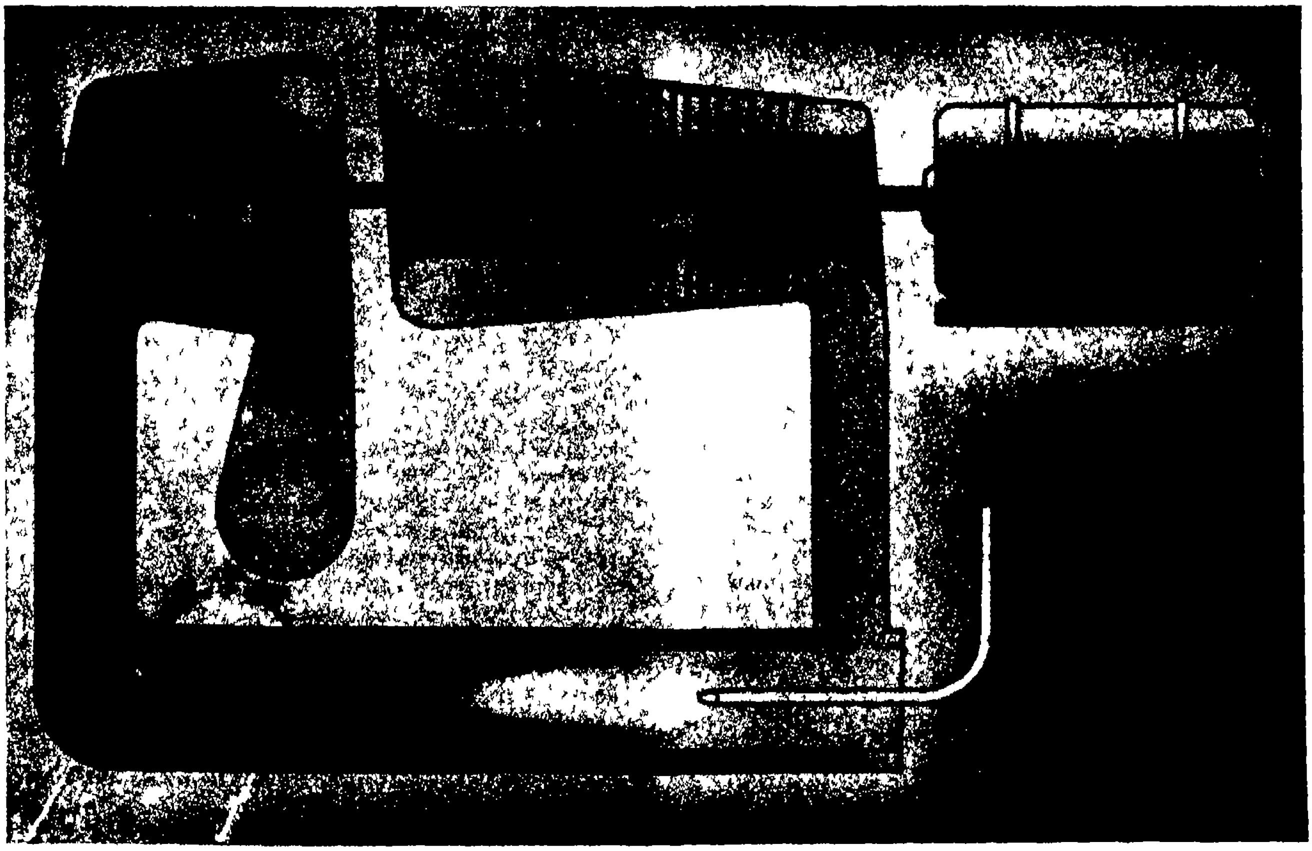
The turbo-propeller-jet power plant has the possibility of competing directly with the conventional reciprocating engine at present-day speeds, since it is to be expected that improvements in design will result in fuel economy and operating life equivalent to those of the reciprocating engine The rapidity of application of turbine power plants to commercial flying is a subject of varying opinion Some estimate that they will be introduced in three years, others in five years, and still others in 10 years or longer However, the rapidity of their introduction will most probably be in direct proportion to the amount and caliber of the effort expended in research and development

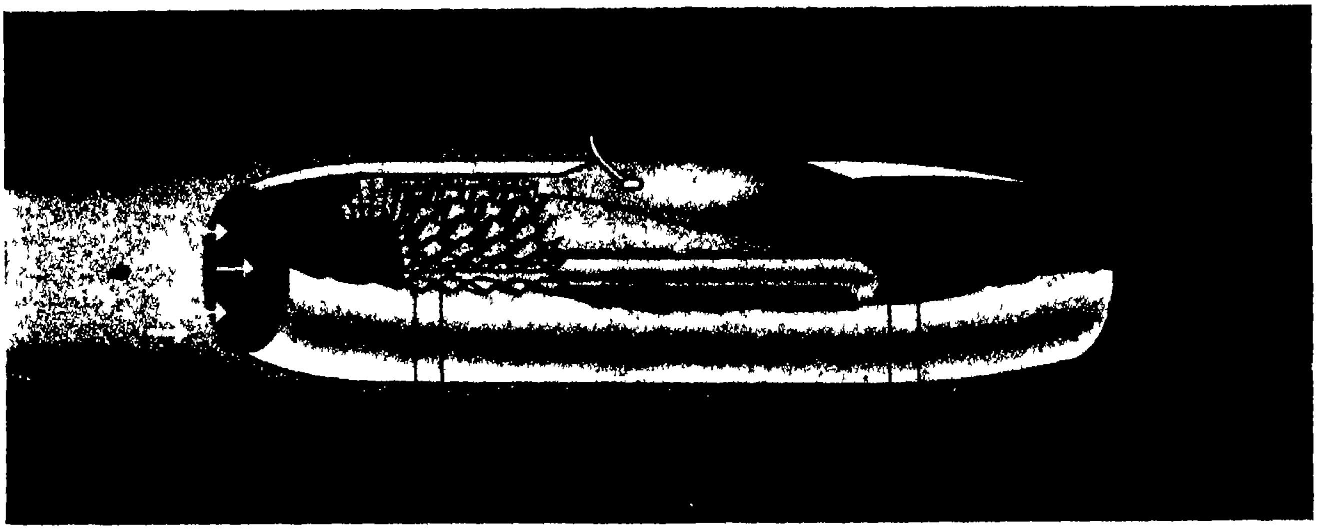
Among the advantages claimed for large gas-turbine installations for marine propulsion are savings in weight and space requirements The gas turbine will, for example, eliminate boilers It should be cheaper to construct than modern steam or Diesel equipment and would eliminate many items of auxiliary equipment, such as condensers If experience obtained in the case of gas turbines in the aircraft field is duplicated, the large-scale gas turbine should also have the advantage of being able to furnish power almost immediately when required The unit should come to operating temperatures very quickly, and any extensive time-lag, such as is needed for the development of high-pressure steam, would not be necessary

NOT JUST ANY FUEL — Many misleading statements have been made about the fuel quality requirements of the aircraft gas-turbine engines One could gather from early publicity releases that these units could burn almost anything that could be pumped and was combustible Such statements do not reflect the actual situation It is true that aircraft gas turbines do not require high-octane gasoline, although many of them have been operated successfully on this type of fuel It has been found, however, that gas-turbine engines perform best on certain specific types of fuels, and these fuels must, in addition to satisfying the characteristics of the gas-turbine combustion chamber, meet a number of specifications which are inherent in any fuel utilized in high-altitude aircraft For example, the fuel must have a very low freezing point in order to withstand low temperatures at high altitudes

From the standpoint of engine performance, a satisfactory fuel for gas-turbine engines must burn cleanly, and must not cause deposition of carbon or coke in the combustion chamber Such coke formation, in addition to being an indication of incomplete combustion with consequent loss in efficiency, may also promote warping and distortion of the metal

Simplified section of a gas turbine. Heated air from combustion chamber is exhausted through turbine, which drives the compressor and also provides power for stationary plants, locomotives, or ships





Power is supplied by the turbo-jet engine through reaction. The turbine operates the compressor and may also power a propeller as in a prop-jet. In drawing, direction of motion is from right to left

liners of the combustion chamber by preventing even dissipation of heat Furthermore, large particles of coke may become dislodged and severely damage the turbine blades

The satisfactory fuel must provide a stable flame over wide ranges of air-to-fuel ratio Flame blow-out must not occur when throttling causes a momentary abnormally lean mixture Similarly, blow-out must not take place in the event of rich mixture caused by quick throttling while the compressor is rotating at relatively low speed Blow-outs might well prove disastrous, particularly in combat aircraft, if re-ignition were not immediately obtained, and such cases might be encountered at high altitude

Finally, the gas-turbine fuel itself and its products of combustion must be of such nature that neither will corrode the metals of which the engine is constructed

Fuels for aircraft gas-turbine engines at the present time range in volatility from that of 100-octane aviation fuel, which is frequently employed because of its availability, to that of kerosine Present indications are that fuels of higher boiling ranges are not entirely satisfactory in the combustion chambers of the gas-turbine engines because, among other reasons, of their low temperature properties

The chemical composition of the fuels may also be an important factor Aromatic hydrocarbons appear to burn less cleanly than those of the paraffinic type On the other hand, in the case of jet-powered aircraft, the aromatic hydrocarbons should have a fundamental advantage because of their higher heat content per gallon, and fuel storage space may become a limiting factor on high-speed planes There are indications that improvements in combustion chamber and accessory equipment design may permit the use of highly aromatic fuels If the use of fuels containing large percentages of aromatic hydrocarbons should ultimately prove to be desirable, it will permit utilizing many products produced by catalytic or thermal cracking, in addition to the more paraffinic products that predominate in virgin crude oil

EXTENSIVE FUEL TESTING — In order to determine the most desirable fuel from a performance standpoint, fuels of all types are being evaluated in full-scale combustion chambers of gas turbine engines The Standard Oil Development Company was the first petroleum company to establish a laboratory for this purpose, and tests are run in all types of currently available units Facilities are on hand for simulating conditions of flight at altitudes up to 40,000 feet By this means, the requirements of newly developed engines can be determined as soon as the engines become available

Knowledge of the fundamental variables controlling high-output combustion is essential for further development of gas-turbine fuels Studies of the fundamentals of combustion are under way in a special laboratory in co-operation with the Office of Naval Research Here the many factors affecting rates of flame propagation, flame stability, and heat release per unit volume are investigated on a laboratory scale The most advanced spectrographic techniques are employed, and it has been necessary to construct numerous unconventional pieces of test apparatus For example, means had to be developed for confining the flame from fuel being burned at a faster rate than in a domestic heating furnace within a space six inches long and one inch in diameter Knowledge gained by these fundamental studies will find application, not only to problems relating to gas turbines, but also to pulse jets, ram jets, improved furnaces of all kinds, and even to combustion in the reciprocating engines

The ultimate selections of the types of fuel to be generally employed in gas turbines will depend upon combustion performance, safety in storage and handling of fuels, and economy of operation The selection of the boiling range characteristics of the fuels will be affected by considerations of maximum probable future demand for other liquid fuels, such as motor gasoline, 100-octane fuel components, kerosine, and Diesel fuels so that the characteristics will not unduly restrict amounts that can be made Assurance of proper performance will come only from extensive research over long periods of time

SCIENTIFIC AMERICAN'S *Industrial Digest*

EXPANSION TESTING

Essential To Understanding of Production Problems

HIGH-SPEED operation in any industry usually means the occurence or the use of elevated temperatures Temperatures in turn mean expanded dimensions of materials And expansion can mean breakage of retaining members, losses of production accuracy, and similar troubles

Courtesy Whip Mix Corporation

Bureau of Standards type Dilatometer

Materials are studied as never before to find out just how much they will expand and under what conditions The data, which must be of scientific accuracy, are obtained from such intricate instruments as the Bureau of Standards type Dilatometer —*E L C*

LINE VOLTAGE STABILIZER

Reduces Variations In Quality Of Photographic Prints

VARYING voltage conditions and the consequent bad effect on the quality of negatives and prints have been eliminated in a lithographic plant by the installation of a voltage stabilizer which delivers a constant output of 230 volts when connected to an ordinary power line whose voltage varies between 190 and 260 volts The influence of other electrical loads on the voltage output is eliminated

Installation of the stabilizer grew out of a study by the Charles M Falk Lithographic Company of the factors controlling the production of good negatives and prints It was discovered that negatives did not produce the same true colors for a given exposure, or, for black and white negatives, the same densities for a given exposure Further studies showed that voltage variation caused by changes of electrical loads on the building circuit produced color variations as a result of unequal voltages at the light source

The General Electric voltage stabilizer, a 5000-volt-ampere transformer network device, was installed for control of the lighting circuit used in the photographic process resulting in a reduction in negative spoilage and lower time losses

FUEL VAPORIZER

Distributes Super-Fine Spray Through Pin-Hole Slots

WHIPPING heavy oil into a miniature cyclone of tiny droplets averaging less than four ten-thousandths of an inch in diameter, a fuel atomizer has been perfected to speed work on a new gas turbine engine, according to scientists at the Westinghouse Research Laboratories Designed by Keith V Smith, the atomizer will be used on a 2000-horsepower oil-burning gas turbine now under development

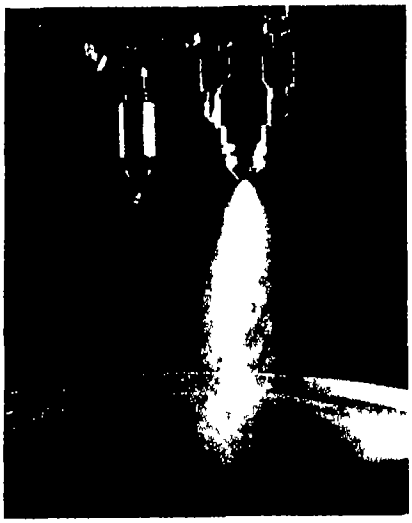
A new-type nozzle that sprays oil into the engine, the atomizer enables a minimum of 96 percent of the fuel to be converted into heat over a wide range of speeds—at times reaching heat-producing efficiency twice that of conventional nozzles

"This is possible," explains Dr Stewart Way, who supervises combustion research at the Laboratories, "because the tiny wind-driven droplets vaporize and burn more readily than the spray from a conventional nozzle, which produces fuel particles some ten times larger

"About 29 billion drops a second are sprayed by the new nozzle, providing a total burning area of one hundred square feet and immensely speeding up the process of vaporization As a result, greater fuel economy now becomes possible, reducing the cost of gas turbine operation"

Key to the new nozzle's atomizing power is a blast of air that enters through six pin-hole slots cut at an angle in the nozzle As these separate streams of air enter the atomizer, their whirling motion stirs up a miniature cyclone This air blast in turn collides with the incoming fuel supply, ripping the thick oil into droplets so fine they approach the size of fog particles

"The conventional method of supplying fuel is to pump oil through a nozzle at various pressures and let the flame do the rest," Dr Way points out "But such a method has two serious disadvantages First when the turbine is running under light loads, the fuel is distributed unevenly throughout the combustion chamber, a large part going to the walls where some of it cakes in the form of unburned carbon particles Second disadvantage of conventional nozzles is that the particles are



Courtesy Westinghouse Electric Corporation

New nozzle (right) emits much finer spray than conventional model (left)

too large for best combustion when fuel pressures are relatively low

"The fuel nozzle designed by Keith Smith goes a long way toward clearing both these hurdles by providing super-fine atomization over a wide range of operations, and by distributing the fuel equally to all parts of the combustion chamber

"A unique feature," Dr Way continues, "is that a very fine spray can be attained at oil pressures as low as 10 pounds per square inch, and even lower if a lighter grade of oil is used With the conventional nozzle, pressures of at least 50 pounds per square inch are required"

CHILLED LATEX

Converted Into Synthetic Rubber Film

CONVERSION of a neoprene latex to a purified synthetic rubber known as GR-M is now possible on a continuous production basis It has been found that a latex of GR-M can be converted into a thin rubber-like film by freezing a thin layer of latex on the surface of a chilled revolving metal cylinder and then scraping off a film of rubber mixed with ice crystals This method avoids the use of chemicals and can be operated continuously in a machine The method by which GR-M is manufactured gives a milk-like dispersion of tiny rubber particles that looks like latex obtained from the rubber tree Before such goods as tires, hose, and other articles can be made, it is necessary to separate the synthetic rubber from the water and chemicals used in the manufacture of the latex. Such a latex can be coagulated by the addition of chemicals or acids and the solid rubber thus obtained But it was desirable to produce the synthetic rubber without the necessity of adding chemicals that must be removed later or by the use of excessive labor

In the new process, developed by E I du Pont de Nemours and Company, the latex is fed to a cold revolving drum, the film of ice and rubber is removed and thawed, and the water is then removed by squeezing the film and passage through drying ovens similar to those used for drying textiles The dried film is very thin and resembles a sheet of elastic transparent paper This film when dried is fed into machines which squeeze it together into the form of a rope about an inch in diameter The roped GR-M is then continuously cut into sections and packaged by automatic machinery ready to be shipped to the fabricators of rubber goods

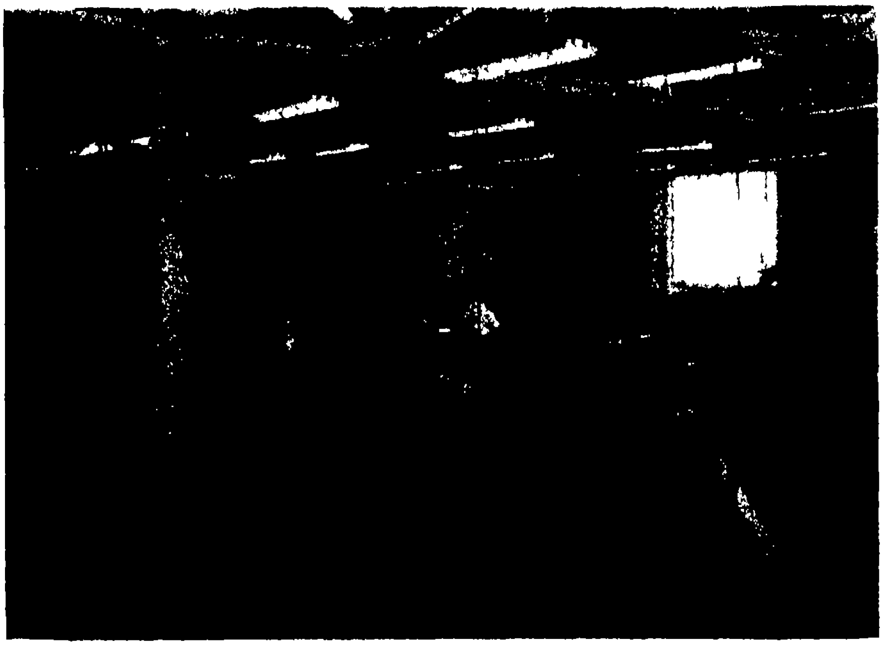
MACHINE-SHOP FORESTS

Return With Installation Of Special Conduits

WHEN BELT drives with their overhead shafting first were reduced in number, many a plant manager sighed happily over the fact that the ceiling space was clear above his machines and his shop no longer looked like a forest

Gradually, the forest appearance is creeping back Compressed air lines, hydraulic lines, electrical connections, circulating steam and hot water, special lubricants, tubes for gravity or pneumatic handling of materials, all are being led down from plant ceilings And with them are coming all of the problems of light without shadows which had existed with the belting

This condition will increase No matter what the engineer may desire above his machines, ceiling space is too handy and too valuable to waste —*E L C*



Convenient overhead space is again taken up—now by a multitude of pipes and cables

MIDGET CAMERA

Disguised As Match-Box, Was Tool of OSS

SMALL enough for concealment in a person's hand and yet capable of snapping pictures that can be enlarged many diameters with excellent clarity, a tiny camera was developed during the war for use by the OSS and underground forces Also the OSS was supplied with "vestpocket darkroom" kits containing several rolls of 16-mm film photographic developing and fixing chemicals in pill form, a small chamois for wiping the developed film dry, mixing spoon, film clips, and a pencil-size solution agitating stick By means of this miniature darkroom equipment, the film could be developed in a small glass holding a jigger of solution

16-mm film is used

The camera, which was planned by J L Boon, Joseph Stoiber, and Henry Hood, all of the Eastman Kodak Camera Works, took film in coils or spools in lengths of about two feet It produced about 30 exposures, had an *f*/5 lens with one stop to close the aperture to *f*/11, and operated at a shutter speed of about 1/50th of a second

With a one-inch focal length, the lens had an angle of view of approximately 45 degrees, which permitted picture-shooting "from the hip" The subject was in focus from about eight feet to infinity

Film coated with standard Eastman emulsions (Super XX or Plus X) was used in the camera, which was constructed of a molded Bakelite inner case sheathed in a metal outer case The entire camera had a dull black finish

Functioning with but a slight click, the "M B" had no view finder and was operated simply by aiming at the subject, then pushing a small plunger A wire lever enabled the operator to take time exposures as well.

For copying photographs or printed matter the camera was set in a small stand equipped with a close-up lens In this manner it served as a photo-recording apparatus for reproducing documents and similar material

INSECTS TRACED

By Tagging With Radio-Active Material

Movement of insects can be followed by attaching a small amount of radium sulfate to them and detecting the radioactivity with a Geiger-Muller tube With this tube and its associated power supply, sufficient output is obtained to operate a loudspeaker directly, and to locate through four inches of soil an insect or worm carrying five micrograms of tracer Periodic ticks from the loudspeaker increase in rate as the insect is approached —*K H*

BETTER LEATHER FINISHES

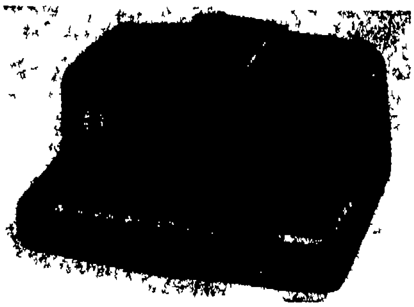
Produced Through Use Of Infra-Red Lamps

Modern scientific developments are being successfully applied to one of man's oldest industries, shoemaking Today, progressive tanners are using infra-red lamps to fix the finishes on leathers They find this superior to the old heat methods, for it permits a second application in a matter of seconds and, in this way, radically reduces the time necessary for finishing

WATCH TIMER

Compares Ticks With Output Of Crystal Oscillator

Newest in watch rate recorders is a device which picks up the sounds of a watch with a microphone, feeds them to an amplifier, and thence to a trigger tube that operates the solenoid of a printing bar A crystal-controlled oscillator serving as the master time clock also acts on the printing bar, so that the slope of the lines printed on a strip of paper indicates whether the watch is running fast or slow A series of lines parallel to the sides of the paper means that the watch is keeping perfect time The instrument, made by the Gibbs Division of George W Borg Corporation, is supplied in a plastics case for counter use —*K H*



Watch rate shown by lines on paper

OFF-SHORE OIL WELL

May be First of Many Far From Land

An oil well 10 miles out in the Gulf of Mexico—the first operation of this nature so far from land—is only a forerunner of others even greater distances off shore, states R G Watts, of the Magnolia Petroleum Company, which drilled the well This well is about 37 miles south of Morgan City, Louisiana, 10 miles off shore from the mouth of the Atchafalaya River The same firm has in process of construction another platform 29 miles off shore Four others are in the planning stage within 10 miles of shore and one more nearly 20 miles out Prospects are that the next few years will see many more wells drilled in the Gulf waters and probably much further out

The well was drilled to a total depth of 12,874 feet with no production At present it is drilling directionally at 10,601 feet from a whipstock set at 10,542 feet

Water at the location site was 16 feet deep at mean low tide There are no other wells between this one and the shore in this general area but there are a few in Atchafalaya Bay, in protected and somewhat shallower water

The quartering of men and transporting them to and from the job site in a reasonable length of time gave promise of being a major problem This was solved in two ways First by establishing a quarterboat near Eugene Island just inside the Bay in semi-quiet waters, and secondly by use of a heavy fast boat as crew boat to transport men between the job and the quarterboat

The distance of the well from land and its location in the open Gulf necessitated providing more platform space or area for storage of drilling mud, fuel oil, fresh water, and standby units than would otherwise be required The platform was set at an elevation of 20 feet above mean high water to give protection against waves of maximum expected height The bracing on the piling was designed for the force of such waves which, due to the open type of structure, would be about 800 pounds per square foot of exposed surface

JET ALLOYS TESTED

By Rapid Spinning At High Temperatures

Scientists are exploding whirling, red-hot disks of metal in an effort to determine the maximum strength of parts for aircraft jet engines This "metal torture" will lay the groundwork for development of new alloys especially suited to this work

Disks of specially-developed alloys, one foot in diameter and one inch thick, will be heated to temperatures above 1400 degrees, Fahrenheit, and spun at a speed of 1200 miles per hour—35,000 revolutions a minute—until they literally fly apart under the combined attack of centrifugal force and heat A specially constructed dugout, ringed with heavy sandbags and sunk 10 feet below floor level, will bear the brunt of the assault

"These destruction tests," explains R E Peterson, manager of the

Looking down into the pit where new alloys are whirled to destruction

Mechanics Department at the Westinghouse Research Laboratories, where the tests are being conducted, "are aimed at revealing the ultimate strength of alloys now used in gas-turbine rotors for jet engine application In actual service, these rotors—on which the turbine blades ride—are subjected to terrific stress and temperatures We plan to simulate and even exceed those conditions until the metal breaks up"

When the actual test is underway the 32-pound disk is covered by a thin steel hood from which air has been evacuated to reduce friction The hood has been constructed purposely of very light steel, one eighth of an inch thick, so that flying fragments of the metal will easily penetrate its thin skin Use of a heavier steel would cause serious damage to the fragments and prevent close scrutiny of the type of fracture or break involved—very vital information to the scientist

As the heated disk spins, research engineers will make continuous measurement of its temperature Methods for doing this posed a difficult problem Since the disk is whirling at the rate of 35,000 revolutions per minute, any heat-measuring device attached to the outer rim would have a centrifugal pull of approximately 190,000 times its own weight Even if the device weighed a fraction of an ounce, it would have to be fastened strongly enough to resist a pull of many thousand pounds The problem was solved by a special welding process

Periodic measurements also will be made of the expanding diameter of the whirling metal disk Under high stress and temperature, all metals tend to flow or "creep," and with the very narrow clearances in the gas turbine, a knowledge of this rate of flow is vital to the design engineer to prevent future rubbing of surfaces

DDT MOTHPROOFING

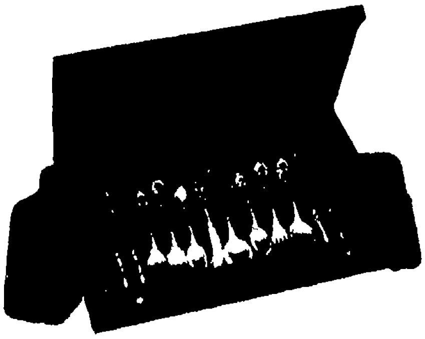
Assures Two-Year Protection From Attack By Insects

MOTHPROOFING clothing by spraying DDT in solution on the material in the centrifugal extractor at the dry cleaner's plant as a last step in the dry cleaning process affords heretofore-impossible protection The treatment leaves tiny traces of the insecticide so distributed throughout the fabric that insects will not attack it for as long as two years or more after treatment, even though the garment be washed in the interim The amount of insecticide left in the fabric is so small that it in no other way affects the cloth, nor does it impart color or odor to the work Application is simple and apparently foolproof, the insecticide is dissolved in the solvent by passing it over a porous bag containing the powder The solution is sprayed on the material in the extractor just before the work goes to the final dryers —*D H K*

FABRIC COATING

Contains No Sulfur, Protects Silverware From Tarnish

PLASTICS-coated materials, this time a cotton-base fabric coated with pyrolylin, are making their appearance in many new applications One is a silver chest sold with Gorham silverware that is coated with Terek, manufactured by Athol Manufacturing Company The advantages of this material is that it discourages tarnishing, being compounded without sulfur —*C A B*



Tarnish retarding chest

PACKAGE BATTERY CHARGER

Is Fully Automatic, Can Not Overcharge

IMPROVED heavy-duty battery charging equipment for industrial truck service, meeting all the standards of the Electric Industrial Truck Association, is now packaged in one unit consisting of a single-circuit battery-charging motor-generator set, with its control cabinet mounted on a welded structural steel framework directly above It is completely wired and assembled before shipment from the factory

The equipment meets the requirements of an 18-cell, 550-ampere hour, lead-acid type storage battery It charges the battery at the exact tapered charge rate that is indicated by the battery manufacturer as being necessary for longest life of the battery equipment.

The generator is a conventional 47-volt D C machine For exact adjustment of voltage, a slide-wire type resistor is used in the field circuit in place of the usual rheostat This prevents tampering with the voltage after it has been set

The equipment, produced by the General Electric Company, is completely automatic Connection of the battery to the terminals automatically starts the motor-generator set, and when it has attained synchronous speed, the line contactor to the battery circuit is closed automatically As soon as the battery has reached a voltage representing 75 to 80 percent of full charge, a timing device is actuated which cuts off the battery from the charging circuit on completion of the charge This shuts down the motor-generator set and prevents overcharging the battery

PEST KILLER TESTED

Seen As Superior To DDT, Nicotine

HAVING shown in preliminary tests that it may be the answer to the problem of controlling pests which are not eliminated by DDT, a new phosphate, tetraethyl pyrophosphate (or TEP, as it will probably be called) marks as its victims rats, codling moths, aphids, and mites which menace such crops as apples, potatoes, peaches, and cabbages

No poisonous residue

The importance of TEP as an insecticide lies in the fact that many of the insects which DDT kills are those which hold other insects in check With the predators eliminated, aphids, mites, and kindred pests flourish Estimates rate TEP as ten times as effective as nicotine

One advantage it possesses is that it leaves no poisonous residue, for it decomposes within a few days after application Thus food products, on which it will be most widely used, need not be washed before marketing

The full utility of TEP in agricultural fields will not be established for at least a year or more Conceivably, it can be used as a spray, or dust component, or as an aerosol ingredient —*H C E J*

CONTROL-CABLE STEEL

Has Expansion Coefficient to Match That Of Aluminum

Having a coefficient of thermal expansion close to that of aluminum alloy, an alloy steel has recently been developed for use in aircraft control cables It has successfully solved the problem of maintaining correct control cable tension when used in assemblies with aluminum alloy over a range of temperatures from − 60 to + 75 degrees, Fahrenheit, and without sacrificing necessary strength properties

The alloy is a nickel-manganese-chromium steel containing 11 to 14 percent nickel, 3 5 to 6 percent manganese and 3 to 6 percent chromium, with 0 3 to 0 7 percent carbon Tensile strengths of 250,000 to 280,000 pounds per square inch, comparable to those of "18 and 8" stainless steel, are obtainable by cold-rolling The material is non-magnetic even after severe cold-working, and its high thermal expansion coefficients closely match those of the aluminum alloys used as cable casing

The alloy will probably also find uses in thermostatic bi-metal parts Applications have been developed for aircraft engine cylinder liners valve seats, and crank case bolts The steel can be nitrided, and seems to have good resistance to impact at low temperatures

A special field of use is expected to be found in applications that require a non-magnetic material with strength greater than that of the nonferrous metals —*F P P*

NOVEL WOOD STILL

Gives Better Yield With Less Fuel

Strengthening of the wood distillation industry in competition with synthetic manufacturer of acetic acid and methanol is forecast by R S Aries, research associate at the Polytechnic Institute of Brooklyn, as a result of a new wood distillation process

The new process developed at the Institute, in contrast to the old-fashioned plants in which wood is loaded by hand into cast-iron trains or "buggies" and placed in heated kilns, uses a steel chamber or retort into the top of which the wood is charged and continuously emerges at the bottom as charcoal The flue combustion gases are circulated several times in the retort, thus drying the wood and saving on the amount of heat necessary for carbonization

Other advantages of the process are a lower investment and a higher recovery of superior quality products By the new process one ton of dry wood yields 1000 pounds of charcoal, 125 pounds of acetic acid and 80 pounds of methanol In comparison, the oven processes now in use yield only 600 pounds of charcoal, 80 pounds of acetic acid and 45 pounds of methanol per ton of processed wood

These improved yields, coupled with mechanized handling of wood, should permit plants to survive the keen competition from synthetic products and establish distillation as a permanent wood-chemical industry in America —*H C E J*

RADIO COMPASS TRAINER

Demonstrates Direction Finding By Sight and Sound

Devised for the instruction of aircraft pilots and radio operators in the use of a radio compass, a trainer demonstrates both visually and aurally how positions of a radio station and an airplane with relation to the north magnetic pole and the radio loop antenna combine to indicate a bearing from airplane to station All of the elements are movable to set up different problems The trainee listens with headphones as he rotates the loop and plane —*K H*

Problems varied by adjusting elements

PLUG-IN CONTROL

Can Be Quickly Replaced If It Develops Trouble

Having captive wing-nut mounting and a multiple-contact plug for all external connections, an electronic control unit allows practically uninterrupted machine operation in a factory When trouble occurs in the control unit, it is yanked out in its entirety, and a spare one plugged in with only a few minutes lost time —*K H*

Entire unit is detached

HIGH-STRENGTH ALLOY

Of Aluminum and Zinc Was French War Time Achievement

From France are now coming reports of war-time developments in the light-metals field which reveal that the French went somewhat farther than the United States in the strength level of their new aluminum-zinc alloys

To obtain the greatest possible strengths, and thus to achieve the maximum weight saving, the French put 8 percent zinc and 2 5 percent magnesium in the alloy (as compared with American alloys containing up to 6 percent zinc) The French alloys (called Zicral) are reported to have 85,000 to 99,600 pounds per square inch tensile strengths, have a specific gravity of 2 8, and to be available as both sheet and forgings, the former clad with a more corrosion-resistant alloy —*F P P*

New Products

PHOTOELECTRIC ACTUATOR

Of High Resolution, Counts Tiny Parts With Great Accuracy

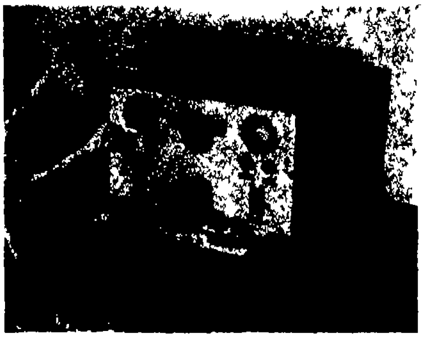
For counting pills, buttons, watch screws, bottle caps, hardware, and other such items, which because of their small size, light weight, or irregular shape, are difficult to count accurately at high speeds, a high resolution photoelectric actuator has a beam approximately 1/16 inch wide and will respond to changes in light level as small as 20 percent Since complete interruption of the light beam is not required for normal operation, objects as small as 0.010 of an inch have been counted with high accuracy This feature also permits the counting of objects which do not have a distinct separation

Can count up to 30,000 units per minute

This Model 600 Photoelectric Actuator, product of the Potter Instrument Company, provides the negative pulses required for operation of that company's electronic counters, and is designed to detect objects at rates up to 30,000 per minute The unit also contains a capacitor discharge output circuit for the high-speed operation of control solenoids such as required for deflector gates and packaging equipment.

SMALL INDUCTION HEATER

Applicable to Short-Run or Production-Line Operation



Full-load out-put—43 Btu's per minute

An efficient source of radio-frequency energy for hardening, annealing, soft-soldering, brazing, or melting operations is found in a low-cost, bench-type induction heating generator engineered for continuous, full-load operation on the production line or for short-run work This unit, delivered ready to use, operates on 120 volt, 60 cycle power, and has a full-load output of 43 Btu's per minute at a normal operating frequency of 450 kilocycles The generator is designed so that water-cooling of working coils is unnecessary, as are any adjustments on the generator when changing from one coil to another Single or multi-turn coils can readily be made by simply shaping copper wire or tubing to the work piece

The equipment is fully protected by a plate overload circuit breaker and an instantaneous line circuit breaker, either of which will automatically shut off the generator if improper line voltage or load conditions should arise

This versatile generator, called Ther-Monic Model 43 by its maker, The Induction Heating Corporation, bridges the gap between slow costly hand treating methods, and large industrial heaters

DDT WHITEWASH

Has Long Lethal Life When Made With Skimmed Milk

Permitting the use of DDT in whitewash coating, a new formula has resulted in the longest-lasting residual effect of DDT against insects yet reported to the Milk and Food Section, United States Public Health Service, according to a disclosure by A W Fuchs, Sanitary Engineer Director, of that agency's Washington office

Using a mixture containing a quart of Pestroy 25 percent DDT emulsion concentrate, a gallon of skimmed milk, and four and a half pounds of high-grade spraying lime, research chemists of the Sherwin-Williams Company produced a whitewash coating which still had a high killing effect on flies 309 days after the coating had been applied (DDT, when applied to surfaces as part of a coating, is usually considered to be lethal for a maximum of two to three months)

Until the development of the new formula, it had been impossible to use DDT with whitewash because the efficacy of the DDT was destroyed when combined with lime and water Skimmed milk as the binder not only makes it possible to lengthen the lethal life of the DDT, but also results in an enamel-like coating that is more durable than water-mixed whitewash.

It is believed that whitewash containing DDT will be widely used in controlling parasites in and around stables, hog shelters, poultry houses, outhouses, and dairy barns and other farm buildings, as well as being applied to basement walls in homes, where it can be highly effective against flies, ants, roaches, and so on.

MULTI-SPOT WELDING

Production Rate Doubled With Battery Operation

An example of the application of battery-operated spot welding machines to mass production is seen in the welding of dust-shield assemblies in the plant of an automobile manufacturer The parts to be assemblied required 11 spot welds A double station machine was designed and produced by Progressive Welder Company to handle both right and left hand dust-shield assemblies The batteries (16 cells, 8 volts) are contained in a housing in the rear center of the machine To the left are a group of package-type chargers, above which is the charger control A total of only 30 kilo-volt amperes—balanced on three phases—is required to keep the batteries charged

In operation, only two "shots" from the batteries are required to complete all 11 welds The first "shot" produces six welds simultaneously, while the second produces the other five welds Production is 300 assemblies per hour, with two men to load and unload With the previous setup, two men could pro-

Dust-shield assembly to be welded

Eleven welds in two "shots"

duce only about 125 dust-shield assemblies per hour The ease of loading the machine reduces the amount of operator effort required, despite the increased productivity Material is 20-gage cold rolled steel Parts are dropped into the fixture and the "start" button is pressed All electrodes come down on the work, with the electrodes acting as clamps. On completing the cycle, electrodes retract to permit removal of the assembly

Advantages of the battery-operated machines include a decreased line load, and ability to perform a greater number of welds simultaneously

COMPRESSOR CLUTCH

Permits Automatic Starting Through Delayed-Action Engagement

Incorporating a "time delay" factor which retards its engagement for a second or more—long enough to permit the motor to come up to full speed before any load is applied—a new mercury-activated clutch makes possible the automatic starting of air compressors The motor is then able to bring to bear its greatest torque, plus the inertia of its rotor to start the load Motor current is greatly reduced, the starting windings are protected, and the need for pressure release valves is eliminated Centrifugal force acting on a small amount of mercury in the clutch manufactured by Mercury Clutch Corporation, produces hydraulic pressure which is dependent upon the "head" of mercury rather than the amount This pressure is utilized without the use of levers or other mechanical means, to cause the engagement of the friction elements of the clutch

No pressure release valves needed

VERSATILE OSCILLOSCOPE

With Three Interchangeable Ray Tubes To Extend Application

The first to permit quick interchange of three different types of cathode-ray tubes through the front panel by means of a plug-in connection, a versatile, portable cathode-ray oscilloscope is a general purpose instrument which has been built especially rugged for use in industrial applications. It is constructed of heavy-duty components which will withstand shock and vibration The unit will handle input voltages up to 850 volts peak to peak, and its exceptionally low frequency response permits the observation of wave forms of 0 5 to 300,000 cycles

Tube plugs in through front of panel

Furnished with this oscilloscope, designated Type WO-60C by its manufacturer, the Radio Corporation of America, is a cathode-ray tube of medium persistence for general applications For the lowest frequencies, however, a long-persistence, flickerless screen is often found desirable A third tube having a short-persistence, highly actinic screen, is best for photographic recording without the effect of blurring The latter two tubes are available as accessories

The WO-60C permits changeover from one type of cathode-ray tube to another in as little as ten seconds This is accomplished by merely detaching a built-in light shield, removing the tube, and plugging in another one having the desired characteristics

PASTE-FORMING RESIN

Easily Processed Without Expensive Equipment

A true polyvinyl chloride paste-forming resin, the first of its type to be made in the United States is a free-flowing white powder with a specific gravity of 1 40 It is easily dispersed in a plasticizer with the use of simple processing equipment Employing proper heat treatment, articles can be fabricated from the new resin, designated Geon resin 100-X-26, that have the same excellent qualities for equivalent resin-plasticizer ratios to those fabricated from the standard Geon resins

The principle advantages of Geon 100-X-26 resin, produced by the B F Goodrich Company, are ease of processing and the use of conventional equipment Both of these advantages eliminate, in coating operations, the necessity for heavy and expensive equipment, and the shrinkage of fabrics commonly encountered in water or solvent system coatings

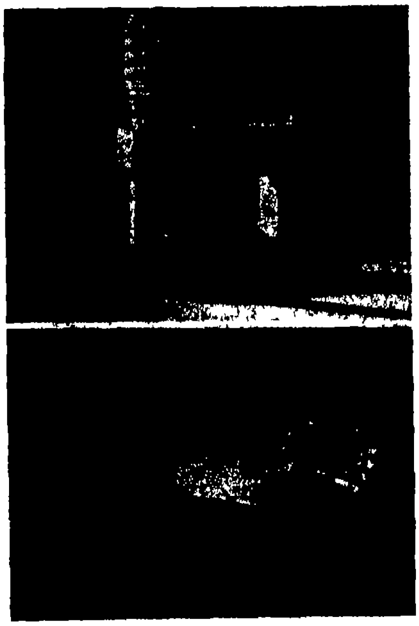
Using the resin-plasticizer formulating method, the fabricator gains the added advantages of 100 percent total solids, no shrinkage of mass due to loss of volatiles, excellent low pressure molding, and thicker coatings with one dip or pass The inexpensive diluent system gives the advantages of rapid release with no retention of solvents, high total solids, and products fabricated with any degree of hardness.

The ease of formulating and processing with Geon 100-X-26 suggests a variety of applications for the new material It may be molded, cast, coated, or dipped to produce the same type products commonly made by calendering—or latex coatings These products include coated paper and fabrics, thin films for curtains or raincoats, and thicker sheeting for upholstery, handbags, and shoes

HOLE-PUNCHING UNITS

Assure Alinement of Punch And Die, Is Easily Set Up

For piercing mild steel of thicknesses up to one quarter inch, new hole-punching units have pedestal dies that permit the punching of angles and channels as well as flat sheets Each unit consists of a holder that carries the punch, die, and stripping mechanism This design eliminates the necessity of attaching punch to press ram, and assures permanent alinement of punch and die Any good mechanic may assemble these punching units into a hole-punching die for operating in stamping presses or press brakes



Unit (above) contains die, punch, and stripping mechanism. Once placed in press, setup (below) needs no further adjustments before punching operation

Setups are made on T-slotted plates or templates for stamping presses and press brakes The setup is simply placed in the press and it is ready to start punching with the first stroke of the press without further adjustment of units or punches and dies The press ram requires only one adjustment regardless of how many hole-punching patterns are placed in operation because of the uniform shut height of these punches, called the Wales Type "CJ" Hole-Punching Units These advantages reduce press "down time" between setups to an absolute minimum

These units are made by the Wales-Strippit Corporation in three holder widths with maximum punch diameter of ⅞ inches

PAINT DEODORANT

Replaces Traditional Odor With One More Pleasant

PAINTS used in homes, factories, and offices can now be deodorized and given an odor of pine, cedar, or other pleasant fragrances that are barely perceptible Added by the manufacturer to oil or water paints, enamels, and lacquers, a series of new chemical products, called Paint-O-Dors primarily neutralize and mask paint odors as the paint is applied and dries The aromatic mixtures are easy to use, inexpensive, and have no effect on the color, viscosity, drying time, or other qualities of paints Giving off a slightly fragrant odor when the paint is applied, the aromatic mixtures, produced by Givaudan-Delawanna, Inc, volatilize completely and leave no odor once the paint is dry

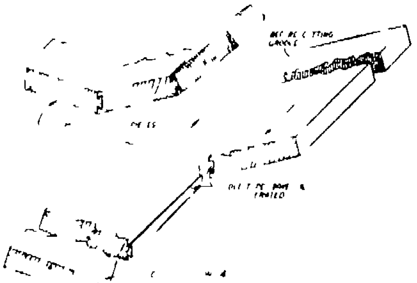
WOOD PREFABRICATOR

Grooves, Glues Pieces for Curved Assemblies Automatically

HAVING adjustable tracks a new Linderman automatic wood fabricator makes possible the prefabrication of angular or "curved" assemblies Using the tilting bed of the machine two pieces of lumber are fed into it from either end Cutters on the machine automatically trim the edges of the lumber to the correct angle, and cut double-taper dovetails in the edges which are to mate These dovetails are so designed that when the tongue first slips into the groove as the boards approach each other, the fit is quite loose As movement proceeds, the fit gradually becomes tighter and tighter, until when completely inserted a tight wedge fit is obtained

Prior to the time when the boards join however, glue is automatically spread on the edges, excess glue being automatically removed As the boards begin to join, the loose fit of the dovetails insures that the glue will be carried into the joint until final position is reached

An accompanying sketch shows the manner in which the joints are produced on the tilting bed type of machine The dovetail taper is considerably exaggerated in this view in order to show the principle involved The strength of the joint produced on the machine, available from the Muskegon Machine Company, is rated by United States Army specifications as being equal or superior to solid wood, the manufacturer reports



The sketch shows principle of tapering tongue and groove as cut by prefabricator

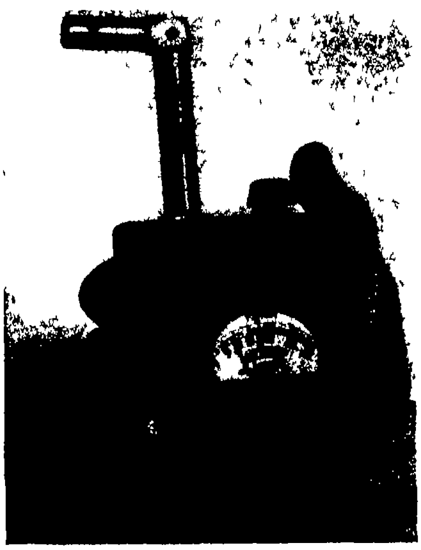
A Linderman machine for prefabrication of curved or angular assemblies

AIR FLOW METER

Accurately Measures Wide Range of Velocities

MEASURING accurately air velocities as low as five feet per minute, an ultra-sensitive air velocity meter is applicable to the measurement of velocities in ducts, of wind velocities, and of flow in air and gas lines, as well as surveys of heating and air conditioning systems The principle of operation is based on a combination of the hot-wire and thermopile principles This arrangement increases the accuracy of the instrument by minimizing the errors due to air temperature variations

The pick-up element is a noble-metal thermopile which is placed in the air stream Alternate junctions are arranged to have much greater cooling than the adjacent junctions which are heated by passing alternating current through the wire The temperature rise of the warmer junctions is measured by the D C thermo-electric voltage generated



May be adapted for remote indication

This instrument, produced by the Hastings Instrument Company, operates from 110 volts A C power that may be obtained either from the house wiring or from a portable power pack that is battery operated The instrument may be adapted for remote indication of velocity or flow of air or other gases The output is suitable for operating standard strip or circular chart electrical recording instruments

The standard range of the instrument is from 0 to 2000 feet per minute Fifty feet per minute is approximately 20 percent of full scale

PHOTOCOPY UNIT

Features High-Speed, Fully Automatic Operation

CAPABLE of turning out twelve 8 by 10, six 9 by 12, or four full-size 18 by 24 inch finished prints per minute, a new self-contained high-speed photocopy unit is fully automatic A single operator stationed in front of the copy board regulates feeding, cutting of paper, and exposure by a push-button control

Exposed prints move automatically through the developing, short-stop, fixing, and washing baths, and then on to the two-drum, single-belt dryer All the processing units are included in one 15 foot long housing, and they can be easily removed individually for simple, rapid servicing The machine, called Foto-Flo, will blow up copy to double size, or reduce it to half its size, with the aid of a projector, it will make enlargements from microfilm Power for the unit, a product of the Haloid Company, is 220 volts, 60 cycles, 50 amperes, with a four-wire line required

METAL ROD CUTTER

For Precision Parting of Round Stock On Production Basis

ACCURATELY cutting, or "parting off," round materials on a production basis without distortion, a new device is reported to offer high speed cutting of rods and bars, greatly exceeding the limits of high-speed turret lathes and screw machines. Called the Di-Acro Rod Parter, it is available in two models, one taking cold rolled steel bars from 1/32 to 3/8 inch in diameter, the other, bars from 1/16 to 5/8 inch. The numerous holes provided in the cutting head permit selection of the hole of the precise size to part the rod without loss of concentricity.

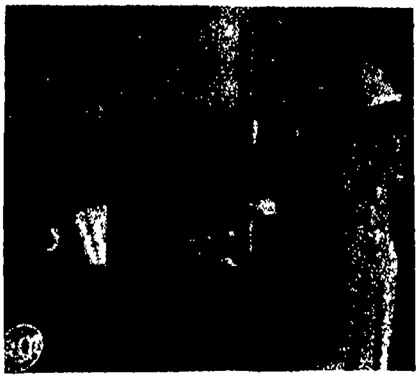
The cutting heads are of heavy tool steel, properly hardened and precision ground. They are reversible, offering double service, and can be removed easily for resharpening. Roller bearings employed in the multiple lever arrangement assure ease of operation. With this device, developed by the O'Neil-Irwin Manufacturing Company, rods of very small diameter, as well as those of larger sizes, are rapidly cut to very close tolerances as to squareness and length, the latter being controlled by a three-way adjustable gage which allows the rods to be positioned quickly and parted with great precision. Although designed principally for use with metals, the parter can be employed also in cutting rods of fiber, wood, rubber, and many types of plastics.

Rods cut accurately

HIGH-FREQUENCY SEALER

Makes Seams of Any Shape Without Machined Dies

Designed for "one shot" bonding of thermoplastic fabrics, a new type of high-frequency sealing press can be adjusted to produce any shape of seal in a thermoplastic material, merely by bending or changing a brass strip (called the die) to fit the desired configuration. This new technique eliminates the need for purchasing the variety of expensive machined dies and die shoes ordinarily required. Seals from 7 to 15 square inches in area can be made in one operation and require only 1 to 4 seconds to complete, depending upon the thickness of the materials to be sealed. It is possible to make seams of any length or configuration that can be accommodated on the platen, which is 14 inches square.


Thermoplastics sealer in operation

"Dies" made of brass strip

Called the RCA Universal Electronic Sealer, it is especially useful for fabrication of plastics balls, pouches, pocket books, belts, and similar items which will fit on the platen. The device produced by the Radio Corporation of America, may be powered by any high frequency generator similar to the RCA Electronic Power Generator, Type 2 BH. In practice, a generator of this type can supply power to several sealer units.

Dies for patterns of unusual shape can be prepared quite simply. First a wooden pattern of the desired contour is made, and then the die strip is shaped to fit. Strips of copper, brass, or steel may be used as die material. Removal of one die and insertion of a new one requires only the adjustment of a few clamps.

PARTS-CLEANING TANK

Has No Moving Elements, Operates By Compressed Air, Gravity

Faster and more thorough removal of oil, grease, chips, and other foreign matter that collect on parts during machining, drilling, boring, grinding, and similar production operations is claimed for an automatic, multi-flow, cold tank cleaner which utilizes a new principle of liquid flow action. Actuated by air volume, pressure differential, and gravity, it cleans parts with a combined liquid scrubbing and solvent action. Tiny metered orifices release compressed air which induces a flow of liquid in an inner tank. The cleaning compound is forced under pressure through and around the parts, cutting films from the surfaces and depositing particles in a static sludge compartment. This tank, known as the Turco Turbulator Tank, is efficient in cleaning small parts that are difficult to clean either manually or with ordinary agitated or still tank. Parts are placed in a wire basket whose wide mesh permits free flow of liquid to penetrate even the most inaccessible ports and channels.

There are four models of the tank, made by Turco Products, Inc, capable of cleaning anything from a typewriter to the largest Diesel motor block. Working space ranges from 1 foot 6 inches by 1 foot 6 inches by 1 foot 4 inches to 6 feet 6 inches by 3 feet by 2 feet 10 inches, with working capacity ranging from 52 gallons to 765 gallons.

PRODUCTION-LINE BRAZING

Joins Three Parts of Varying Sizes In A Single Operation

An interesting metal-joining operation is that by which three parts of a lawn-mower rotor are united in one operation. The parts—spider, drive shaft, and bearing-retainer—arrive at the brazing station cleaned and ready for assembly. The assembler first places four spiders in a ceramic fixture and brushes the center hole of each with flux. A 5/8 inch inside-diameter ring of Easy-Flo brazing alloy made from 3/64 inch diameter wire is slipped on the drive shaft. Next, the end of the shaft and the brazing alloy ring are liberally brushed with flux. A bearing retainer is placed over the shaft end, and the two parts are inserted in place on the spider. The fixture with four such assemblies is then ready for the heating operation.

An induction heating unit with two brazing stations is equipped with jigs for aligning and maintaining close tolerances between parts, especially between the drive shaft and bearing retainer. The fixture holding the four assemblies is placed over the heating coils, and all heating is done from the bottom. Heat can be concentrated on the heavier parts—the drive shaft and the spider—thus preventing warping in the lighter gage bearing retainer. With coils so arranged, the brazing alloy is drawn through the joint, bonding the

Three part assembly at brazing station

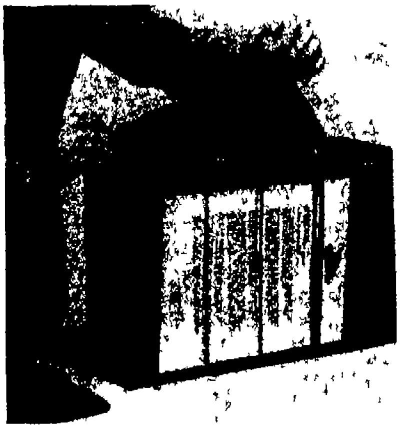
parts together accurately and permanently

With two brazing stations, one heating while the other is loaded, a production of 3840 units has been maintained per eight-hour day in the plant of the Reading Hardware Company

PHOTOGRAPHIC TRAY

Standing Vertical, Has Separate Sections for Developer, Fixer

Eliminating the need for the operator to put his hands in the chemicals, a vertical, splashproof, photographic tray is divided into two compartments, one for developing, and one for fixing The print to be developed is put in a clamp and lowered into the developer, where it is fully visible through a yellow, transparent front which filters out light harmful to either chemical or print When development is complete, the operator lifts out the print by holding the clamp, and lowers it into the fixing compartment, which has room for six prints Special grids guide the papers into the solutions, and prevent them from floating, curling, or sticking to the sides Known as the Pronto-Tray, it also eliminates the use of chemicals storage bottles, as the cover slides on, and protects the chemicals from light and air Thus the tray is always ready for instant use



No need for chemical storage bottles

This tray, made by Pronto, Inc, handles prints up to 9 by 15 inches and its overall dimensions are 15½ inches long, by 10 inches high by 5 inches deep A three compartment model, for developer, stop bath, and fixer, is also available

SMALL BLOW TORCH

Burns Dry Chemical Fuel In Tablet Form

Representing a complete departure in design and principle from blow torches now on the market a new torch uses a dry chemical fuel in tablet form, which eliminates the possibility of spilling, evaporation, or explosion The torch weighs only a few ounces, is completely portable, and is ready for use at a moment's notice, there being no preheating period It is equipped with a brass cup to receive the fuel tablets, a brass tube which supports the cup, and an adjustable clip member The air-cooled handle is formed of nickel plated steel, and the mouth tube is of clear, sanitary, flexible plastics. When in use, only gentle blowing is necessary

No spilling or evaporation of fuel

The fuel tablets, known as Super Fuel, are convenient, clean, and inexpensive Each tablet burns about ten minutes, giving intense heat, leaving the work clean and without residue They may be extinguished and relighted Measurements with a thermocouple indicate temperatures in excess of 2000 degrees, Fahrenheit

The torch, called the Super Jet Blow Torch by its maker, the Birk Manufacturing Company, is suitable for soft or silver soldering, light brazing, annealing, or hardening of small work, finding application with electricians, mechanics, model makers, chemists, dentists, jewelers, and so on

CO$_2$ TIRE INFLATOR

Also Serviceable As Fire Extinguisher

With two primary functions—inflating tires and extinguishing fires—a strong steel bottle filled with compressed carbon dioxide, and equipped with a control valve to release the gas as desired, is furnished with a short hose so that it can be connected to any standard tire valve The unit, a product of Beacon Devices, contains a sufficient amount of carbon dioxide to inflate three average tires from flat to safe driving pressure, the inflation taking from four to ten seconds The gas cannot harm the tire in any way, since it is rated as an effective rubber preservative

Tire inflated in four to ten seconds

The unit, called Tireflater, extinguishes fires in liquids or vapors, and since the gas is a non-conductor, it is a safe medium for attacking fires in electrical systems

CORDLESS SOLDERING TOOL

Adapted From Standard Soldering Iron

Designed for intricate work, a pencil-type cordless soldering instrument is well suited to such delicate mechanical operations as the assembly of small switches, electric meter work, model making, or dental technicians' work

For fine soldering operations

Called the Kordless Kwikheat, it is placed into operation by replacing the soldering tip of any size Kwikheat electric soldering iron with the heater-receptacle unit, plugging-in The forged tellurium copper alloy tip holds approximately 680 degrees, Fahrenheit, for nearly one minute, and reheats in approximately 20 seconds by re-inserting into the heater-receptacle, similar to the manner in which a desk pen-set is used The heater-receptacle and the normal soldering tip are quickly interchangeable in the iron

For exceedingly fine work, and without the annoyance of a cord to foul sensitive equipment, the Kordless Kwikheat, manufactured by the Sound Equipment Corporation of California, will speed the soldering work of technicians engaged in the production of intricate parts.

AUTOMATIC SEGREGATOR

Sorts Parts Too Large or Small From Those Acceptable

Permitting low-cost, fully-automatic inspection of small parts, an electronic segregator sorts the parts into three classifications oversize, acceptable, and undersize Accurate to 0 000010 inch the selector will sort parts with tolerances from + or −0 0001 to + or −0 005 at speeds up to 12,000 parts per hour

The selector consists basically of three units the gage head, the master

Speed limited only by rate of feed

control, and the segregator. The head, where the actual measurement is done, is so designed and constructed as to have no frictional moving parts, no coils, no switches, and no magnets to need adjustment. Because of the unusual electrical circuit, the speed of operation is limited only by the rate at which parts can be fed into the selector. Fully automatic and semi-automatic feed mechanisms are available.

Designated Model DS-20, it comes as a "packaged unit" ready for operation. Besides the gage head, master control, and segregator, the gage head stand, the table, chair, and three tote pans are furnished. The selector is quickly and easily adjustable. By using gage blocks it can be set in a few minutes. Besides having red and green indicating lights, the master control unit has on it a graduated indicating dial gage providing visible readings of the size of each part as it is being sorted. This gage, manufactured by the DoAll Company, is electronically operated and hermetically sealed against dust and moisture.

AUDIO COUPLER

With Resistors and Capacitors Joined By Printed Silver

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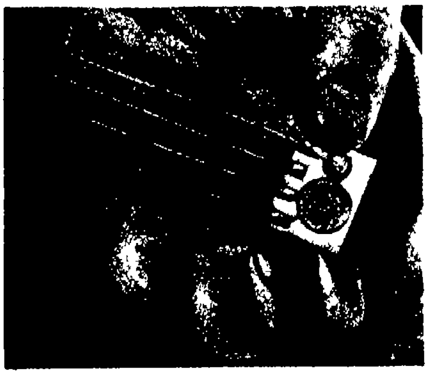

Complete audio coupling unit

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Tolerances of 0.0001 are easily held

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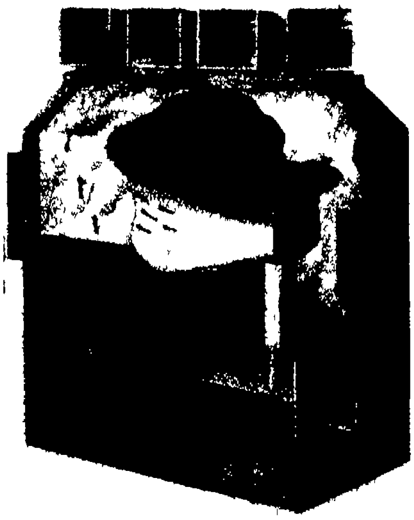

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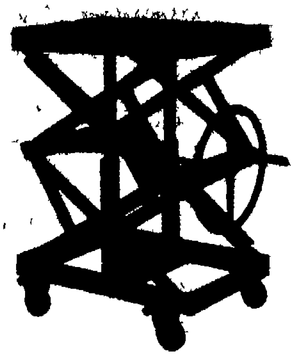

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CASCO GLUING CHART is a new edition of a chart which describes the required properties of glues for various jobs and lists the glues recommended for each Glues listed are Casco Powdered Casein Glue, Cascamite Powdered-Resin Glue, Cascophen Resorcinol-Resin Glue, and Casco Flexible Cement *Casein Company of America, Division of the Borden Company, 350 Madison Avenue, New York 17, New York—Gratis*

MODERN GAS CARBURIZING PROCESSES AND EQUIPMENT This 16-page bulletin is a comprehensive compilation on modern gas carburizing — how it is accomplished and its related processes of suspended carburization, carbon restoration, and dry cyaniding *Surface Combustion Corporation, Technical News Bureau, Toledo 1, Ohio — Gratis*

CAREER OPPORTUNITIES IN AVIATION, A Handbook of Vocational Information. Prepared by the National Council of Technical Schools, this 31-page pamphlet defines almost all occupations in every branch of the aviation industry, and presents accurately duties, qualifications, and opportunities This booklet is optimistic, but reasonably so It will be of aid to all interested in aviation as a career *National Council of Technical Schools, 839 17th Street, N W, Washington 6, D C—Individual copies, 15 cents*

LIFE THROUGH THE AGES, by Will E Burnett, is a visual approach (mainly pictures) to the general story of living things in the earth's long past, with a remarkable table of time periods It is non-technical, popular, and evidently intended to inspire the youth, but adults would find it equally fascinating *Stanford University Press, Stanford University, California —$1 00*

MACHINE TOOLS FOR EVERY MACHINE SHOP AND WORK SHOP is an eight-page bulletin illustrating and describing time-saving bench machines for industrial and home shop use, including inclinable punch presses that stamp, crimp, mark, punch, rivet, and form, milling machines that are easily converted from a vertical to a horizontal miller, and bench machine accessories such as rotary tables, collets, and swivel vises *Benchmaster Manufacturing Company, 2952 West Pico Boulevard, Los Angeles 6, California — Gratis*

THE STRUGGLE FOR ATOMIC CONTROL Written by William T R Fox, Associate Professor of Political Science at Yale University, this 32-page pamphlet explains the necessity for international control of atomic energy and traces the efforts of the United States and the United Nations towards an effective control system A useful and very readable guide *National Committee on Atomic Information, 1749 L Street, N W, Washington 6, D C — 20 cents*

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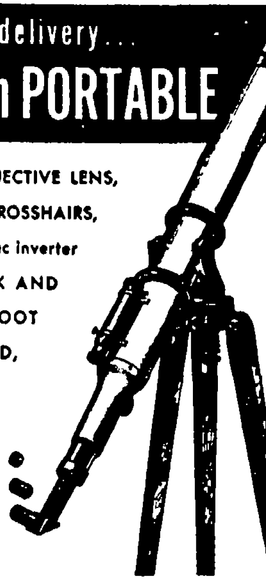

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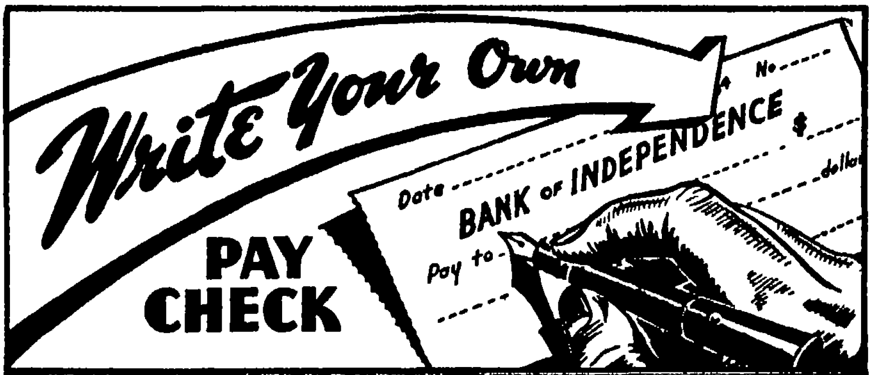

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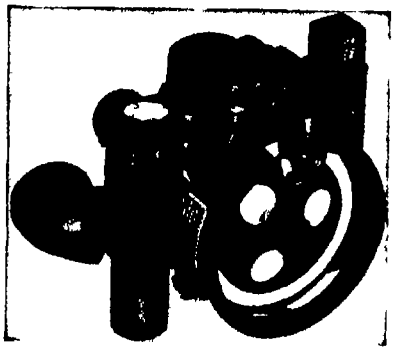

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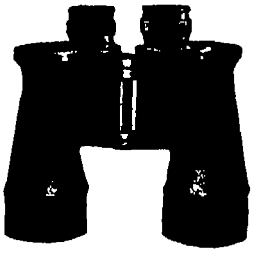

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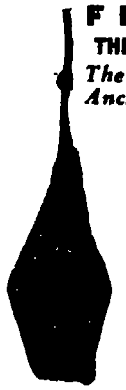

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IN THE APRIL number, Dave Broadhead, Wellsville, N Y, a leading member of the war-time Amateur Roof Prism Gang, described his "moist" technique of mirror figuring and in June told how he made a pair of matched 36" mirrors In July his modified Draper machine was described, and this month he gives compact working instructions for operating such machines with subdiameter tools Except for fragments in Ritchey's classic book now out of print and rare, and a valuable paragraph by Ferson in "A.T.M.A," page 84, (printings since 1944, June) nothing has been available to give the owner of a Draper machine his start in life What follows will therefore be valuable By Broadhead

NEARLY all machines used in precision optics are basically related to the Draper, with the following characteristic adjustments

1) Rotating table, very slow—½ to 8 r p.m according to size of work, speed being governed by optimum balance of accomplishment against heat.

2) Reciprocating arm driving tools over work (stroke, *S*, Figure 1) at rate several times that of turntable—perhaps 5 to 1 Means to vary the length of stroke

3) Means to vary the offset, *O*, or average path distance of the reciprocating arm from the center of the work

4) Means to de-center, *D*, the driving pin so that more of the stroke takes place on one side of the center of the work than the other—usually only a fraction of an inch

5) Variable ratio (cone pulley, for example) drive, so that speed of machine can be adjusted to size of work

It is convenient to designate sizes of grinding and polishing tools, also stroke lengths and offsets, in abstract terms of decimal fractions of the size of the disk being worked Thus, discussion becomes applicable to any size of work

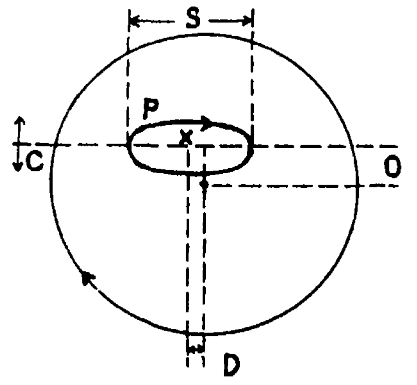

Figure 1: Draper machine elements. *S*: Stroke length. *O*: Offset. *D*: Decentering of drive pin. *C*: Small changes to help clean up zones. *P*: Path of drive pin. *X*: Center of ellipse described by pin on arm

The discussion which follows will be confined to the tool on top method

A good grinding tool should be channeled It should be driven by a pin which bears deep down, close to the working surface, to reduce tilting thrust Most important of all, it should be possible to *choose* a tool of such size that stroke can be balanced against overhang at will and thus gain fairly evenly distributed abrasion over the entire work, as will later be explained Roughing tools of 0 66 (2/3) work diameter, and finishing or "truing" tools of 0 83 (5/6) work diameter, are strongly recommended Their use is common practice My tools are made by cementing blocks of glass on a steel backing but, instead of making the two tools described, I make only one, of 0 83 diameter, and make the outer ring of thinner blocks so as, by normal grinding down, to contact the work about when it would be desired to shift from the 0 66 to the 0 83 size If this shift happens too soon it is easy to grind off the outer ring on a grinding disk or even on a wet grindstone

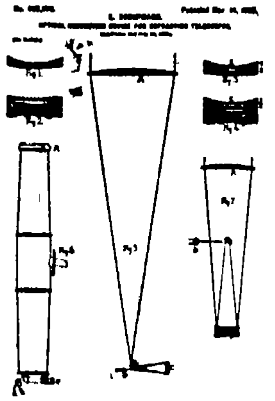

Figure 2: From the patent

The roughing tool is used with a stroke which passes near the center of the work and extends so that the edge of the 0 66-diameter working part of the tool just passes over the edge of the work This tool is used with the coarsest abrasive until *full* depth of sagitta is reached Sagitta should be measured with a spherometer having micrometer dial indicator—an inexpensive one is good enough for average needs—or one having a micrometer movement

When full depth is reached the outer

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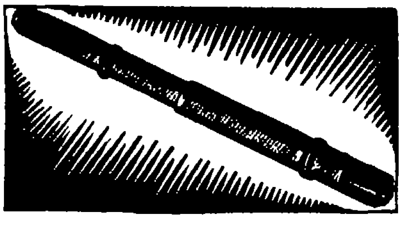

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ring of glass blocks should start working, now an 0 83 tool If it does, the stroke (*S*, Figure 1) is readjusted to about 0.35 diameter and the offset, *O*, to about 0 2 If however, the outer ring of blocks does not yet hit it will be necessary to take a longer stroke—say 0.5 stroke and 0.3 offset—to hold the sagitta fixed till all the blocks are grinding

We are still using coarse abrasive Now assume we have run a wet or two with 0 35 stroke, 0.2 offset, and with the 0 83 circle of blocks all working We read the spherometer and note whether we are deep or shallow If too deep we run with 0 5 stroke and 0 3 offset to shallow the curve If too shallow a very short 0 2 stroke with 0 1 offset will deepen it a bit Still on same grade of abrasive

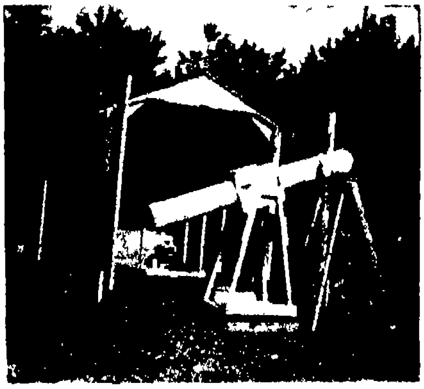

Figure 3: Schupmann experiment

When finally we have the right depth we change to next grade of abrasive We must now discover the *exact* combination of strokes that will hold the desired depth of sagitta This is very important It is about the only "secret" I know It is important because it is the combination of strokes which after shaping has been accomplished, will yield and *hold* a sphere (Dévé's "condition of uniform wear" Deve, "Optical Workshop Principles") without resort to guessing and other monkey work, while work whose radius is constantly being changed is having the center or else the edge ground faster than the other and therefore has differing zonal radii True, an approach to uniform wear, an oscillation around a sphere may be had by working half time erect, other half inverted But an 0 83 tool is enough smaller than the mirror so that the stroke can be made concaving, convexing, or neutral, at will Since machines and workers differ it is difficult to state an exact set of ratios that will yield a sphere Start, perhaps, with an 0 3 stroke and 0 2 offset and after each wet measure the sagitta

Don't change to the third grade of abrasive until, by small changes in the adjustments, you have found the neutral position accurately When you have it, grind and polish by it

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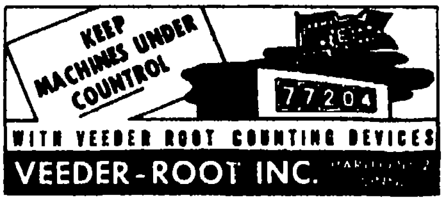

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made evident—usually painfully so

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Parabolize with small star tools, using great caution since a machine cuts fast Overcorrect a little, then run the 0 83 lap a few moments (after careful pressing) on the neutral stroke to reduce the correction and smooth the figure O Hell, it's late and I've got to go to bed

End of Broadhead's notes

Of course, after you get your hand in you will begin formulating your own rules which will probably differ, just as you differ These then will be the correct rules—for you The idea, *often encountered, that there must* somewhere be a single correct method in everything optical is hogwash

THE SCHUPMANN telescope seeks a parent Joseph Dwight, Hyannis, Mass , writes

In 1899 Ludwig Schupmann, a German, was granted U S Patent 620,978 for the telescope that bears his name It has the closed tube and long focus of the refractor, and the convenient view and short tube of the reflector Imagine a conventional Newtonian, with a concave lens of crown glass resting on the mirror, and a convex lens of the same crown glass at the top of the tube and you have the Schupmann, as in 7 of the patent illustration, Figure 2 The concave lens corrects the color error of the convex lens, and the mirror keeps the rays convergent in spite of the concave lens The concave lens and the mirror may be combined in a concavo-convex lens whose convex lower surface forms the mirror, as in 1 The separate mirror and corrector are shown in 2

It seems that no one has taken the trouble to design a completely satisfactory Schupmann and that, perhaps for this reason, no completely satisfactory Schupmann has yet been made It is therefore worth while to give the dimensions of a Schupmann which gives a good degree of magnification, though the field is small

The lenses are of rolled optical plate made by the Pittsburgh Plate Glass Co $N=1\ 52$, $V=58\ 8$ The objective and corrector have the lower face plane, and the radii of their curved faces are 58 4" and 26" respectively, and that of the mirror is 56 8" The distance from objective to corrector is 58 75", and that from corrector to mirror is 0 55" These distances are measured between the edges The diagonal is very close to the objective, and therefore not as in 7 The advantage of a separate mirror is that the mirror, if it has too shallow a curve can be placed farther back of the corrector If the corrector and mirror are combined in one lens, the curves must be exactly right All previous makers seem to have submitted to this handicap

I used 8" disks, which exactly fitted a strong paper tube This facilitated accurate alinement, which is essential The objective was stopped down to

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6", and the focal length was probably about 150" A 1" monocentric eyepiece gave an actual field of about 12′ As the tube was not mounted, an unsilvered diagonal was used, and only the moon was observed The color correction seemed satisfactory, and the definition very good

I believe that this telescope is superior to the Newtonian for magnification, owing to the great focal length and the closed tube And the protected position of the silvered or aluminized mirror should be noted The field probably has considerable curvature, but with a small field this is not very objectionable It is, however, perhaps the chief fault that a designer should try to eliminate I should add that my lenses were repolished by Mr G E. Gordon, a skilled amateur, of 6 Franconia Avenue, Natick, Mass

Perhaps the easiest way to make a Schupmann would be to grind a plane mirror on the plane face of the objective, and an equi-concave corrector on the convex face If the silvered plane mirror is placed at the bottom of the tube, the lower face of the corrector will act as the concave mirror This combination can be tested on the moon and, even if not satisfactory, it will probably help one to estimate the best curvature for a concave mirror to replace the plane It may then be necessary or desirable to give the corrector non-reflective coatings Should the focal length of the objective be found inconveniently short in relation to that of the corrector, which I think unlikely, it can be lengthened till the proportion is the same as in the actual Schupmann described above And the mirror can be made to correspond

When the lenses of a Schupmann are correctly spaced, the image of Venus, both inside and outside focus, will be pure gold The objective should be permanently fixed and the corrector and mirror should be adjustable as a unit If this unit is tilted, one edge of the moon's image will be reddish, and the opposite edge bluish The moon's brightest crater, Aristarchus, should be colorless

My telescope shows that the Schupmann should not be condemned because the first attempts were failures, and that high-priced optical glass is not absolutely necessary But ordinary plate glass or Crystallex are not recommended And it will be safest to begin with an $f/25$ telescope·

Figure 3 shows the tube in a very crude mounting, used when I first experimented with this telescope, and is from Scientific American, 1943 April The present tube has the lenses repolished and relocated, and they now give a much better image The tube is, however, unmounted, as I prefer to give my limited skill and energy to the making of an 11½" Schupmann having an equi-concave corrector, which I have begun I hope that someone with more skill will make and mount a good Schupmann, and that some designer will show us how to get as good achromatism and as flat a field as possible But I think the design given needs no apologies, provided alinement and adjustment are good

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27 OCT 1947

INDUSTRIAL DRAMA: An aura of mystery surrounds many photographs of arc welding processes, such as the one on this month's cover Not so mysterious are some of the reasons why handicaps are being placed on arc welding in many quarters. See the article starting on page 101 of this issue

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50 Years Ago in . . .

(Condensed from Issues of September, 1897)

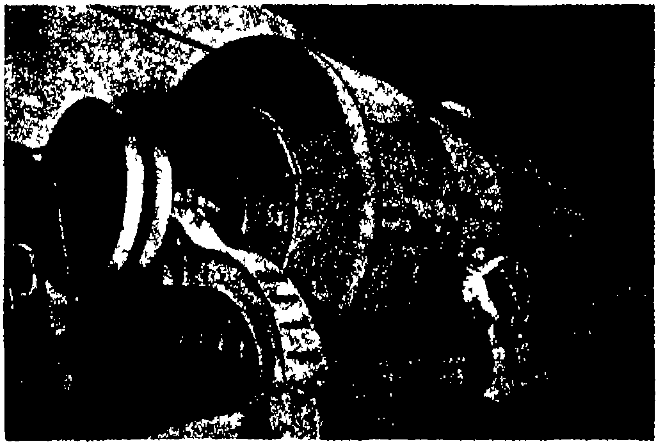
CANAL PROGRESS — "The British consular officers at Panama and Santa Martha describe in their last reports the present condition of the work on the canal across the isthmus and of the railway connecting the Atlantic with the Pacific The New Canal Company, formed in Paris in 1894, to continue and complete a ten lock canal rising to a maximum altitude of 133 feet 8 inches, in place of the original sea level scheme of M De Lesseps, has made good progress with the small capital at its disposal, and the reduced canal trough, or cunette, in the Emperador and Culebra sections is now assuming definite proportions"

ELEVATORS — "The comparative novelty of the elevator and the fact that it carries its passengers in midair invest it with ideas of greater risk than are commonly associated with other methods of conveyance, as by train, car or steam ship As a matter of fact, statistics show that, for the number of passengers handled, the accidents are fewer on first class elevators than upon street car lines or railroads"

RAIL EXPANSION — "The extraordinary activity in railroad construction between the years 1885 and 1892, when the total construction for one year alone reached a total of over 12,000 miles, will explain the enormous demand for steel rails At the close of that period some of the ablest railroad men in the country gave warning that the country was being over-supplied and stated that most of the country contained more railroads than would meet its needs for the next quarter of a century"

GAS DETECTION — "For detecting deleterious reducing gases such as carbonic oxide, methane, etc, in the air of mines, A Mermet finds a dilute solution of potassium permanganate, containing a little nitric acid, highly efficient, the effect of these gases being to decolorize the permanganate solution"

TURBINES — "What is probably the largest and most powerful pair of horizontal turbines, for the head of water under which they will operate, that has ever been built, has recently been erected by the Dayton Globe Iron Works Company, for the Boston and Montana Consolidated Copper and Silver Mining Company, of Great Falls, Montana The two turbines and the draught chest are inclosed within a huge cylindrical flume, 14 feet 4 inches in diameter and 32 feet 6 inches long The body of the flume is built of ½ inch tank steel and the ends are closed by massive cast iron covers, the turbines and draught chest being thus entirely inclosed The wheels were guaranteed to show an average efficiency of 80 per cent from three-quarters to whole gate and develop 2,800 horse power under 40 feet head"



ELECTRIC TAXIS — "In London a company has placed a dozen electrical cabs in the streets They resemble coupes, and the accumulators consist of forty cells, capable of propelling them over fifty miles, at a cost of fifty cents The rear wheels do the driving and the front wheels do the steering They have heavy rubber tires and upholstered spring cushions, are lighted by electricity, are speedy, and almost noiseless"

POSITION FINDER — "Nothing is worse than fog at sea To lessen the danger which then exists, Professor E C Pickering, the director of the Harvard College Observatory, suggests a method of determining the position of a vessel in a fog based upon the velocity of sound If two fog horns of different pitch be placed at equal distances from the middle of a channel or entrance to a harbor, and be sounded simultaneously at regular intervals of about a minute, it will be evident that a captain of a vessel will be able to locate his position with fair accuracy by noting when the sounds of the horns are heard"

DIVING BELL — "An improved diving bell of great capacity moving along the sea bottom by means of screws moved by electricity, is on exhibition in Paris It is lighted by electricity, which also furnishes motive power for any tools that may be used"

100 Years Ago in . . .

(Condensed from Issues of September, 1847)

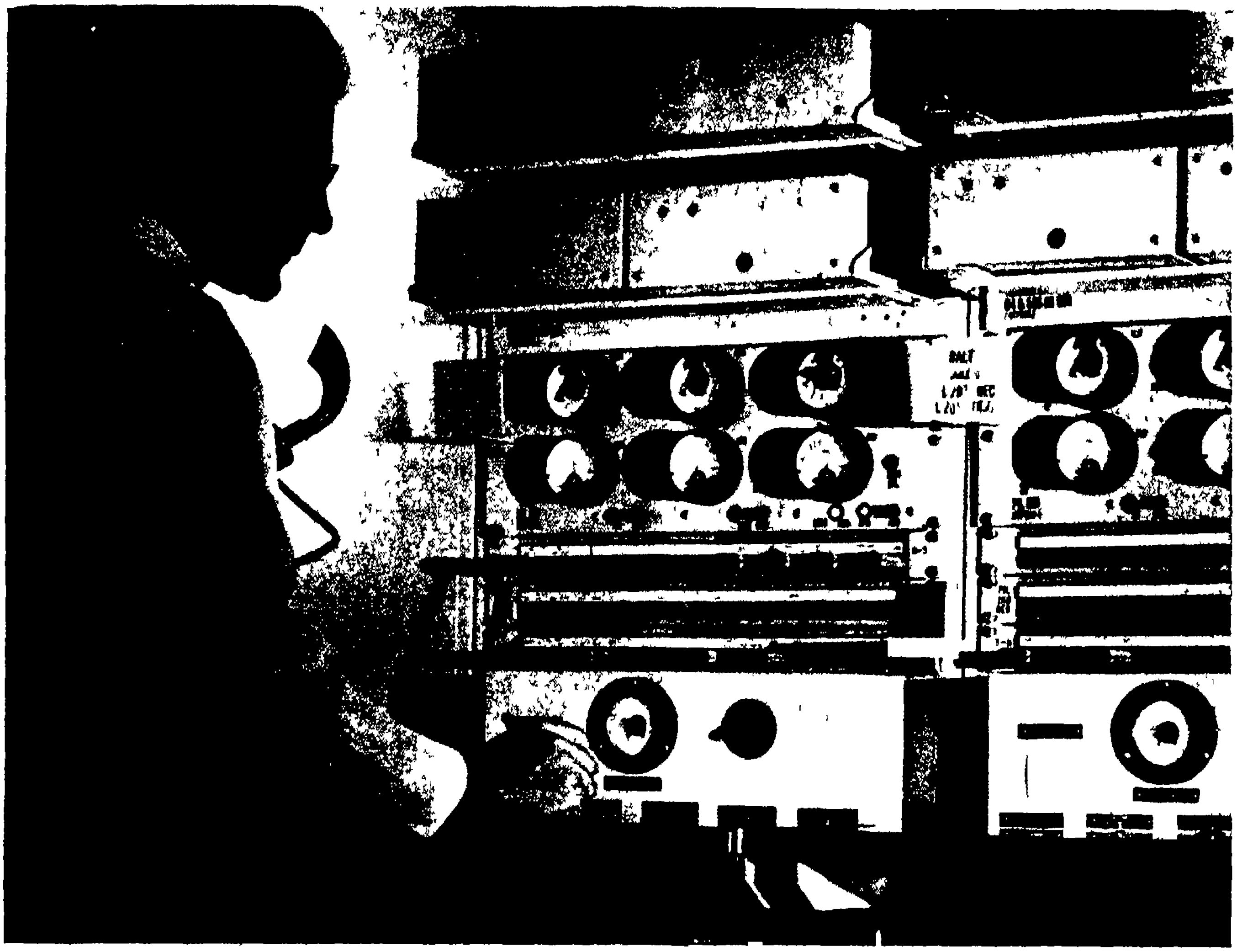
NOW A POPULAR SONG -- "There is a woman in the west who is so large round the waist that her husband can't hug her all at once, but when he takes one hug he makes a chalk mark, so as to know where to commence the next time"

WATER PIPE — "The various contracts made in Pennsylvania to furnish iron pipes for the Boston Water Works amount in all, to between seven and eight thousand tons Messrs Merrick & Towne, alone, of Philadelphia, are filling up a contract for one thousand of the thirty inch pipe, to form the principal main between the pond and the city"

STEAM BOAT WANTED — "The Oregonians are determined to have a steam tow boat, so that vessels may be brought up the Columbia River with safety The wind blows down the river five months of the year, and vessels are said to be two months in sailing up 100 miles, whilst the difficulty could be easily overcome by steam, and a large trade opened with the Pacific"

FALLS DISCOVERED — "There has been a new water-fall discovered in the river of St Louis This cataract falls into the Western part of Lake Superior, which has not yet been described by the geographer The volume of water is immense, and the height of the fall is fifty feet."

CHROMIUM — "Chromium is a metal of a greyish color, very difficult to fuse It unites with oxygen and forms a fine green oxide This is the basis of a fine yellow paint"



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Without automatic regulation, the precise control of energy in the Bell System's long distance circuits would be a superhuman task So Bell Laboratories, which in 1913 developed the first high vacuum electronic amplifier, went on to devise the means to make them self-regulating in telephone systems This is one reason why your long distance call goes through clearly, summer or winter

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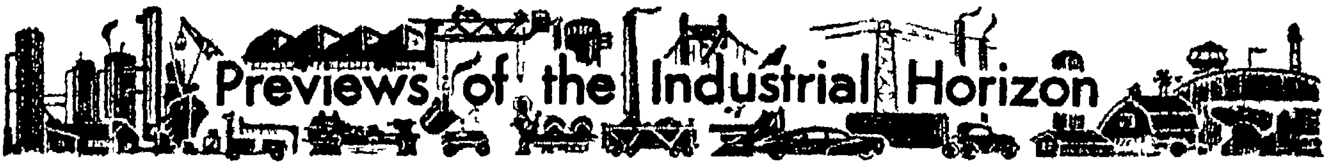


Previews of the Industrial Horizon

By A. P. Peck

FIGHTING FRICTION

Under the title "18,000 Ways to Fight Friction," an article in our October issue will tell the complete story of anti-friction bearings and their little-short-of-miraculous performances in modern industry Some examples Farm machinery, formerly equipped with plain bearings requiring an hour or more a day for adequate lubrication, now is built around anti-friction bearings which require greasing only once a season, saving not only time but also fuel and oil as a result of easier starting and running Users of industrial conveyor belts have found that ball and roller bearings not only stand up better under adverse operating conditions but also have far lower replacement records than plain bearings There are some 2700 anti-friction bearings in the new XC-99 Consolidated Vultee transport plane which, weighing 265,000 pounds, will be capable of carrying 100,000 pounds of cargo, the bearings are in the six 3000-horsepower engines, the landing gear, ailerons, rudders, flaps, and so on

Thus is exemplified the increasing importance of anti-friction bearings, from the size of the lead in your pencil to the size of your hat and larger

KEEPING IT COOL

Reported to have a lower thermal conductivity than still air, heretofore theoretically considered the most efficient thermal insulator a new material is 6 percent silica and 94 percent air Chemically known as an aerogel, this new insulator is so efficient that it will make possible an increase in refrigerator and freezer capacity of up to 60 percent Preliminary reports on practical applications of this insulator indicate that a household refrigerator using it can be increased from seven and a half cubic feet capacity to eleven cubic feet, merely through the reduction in wall thickness made possible by the efficiency of the new material, available as a fine powder or in irregular lumps up to one half inch in diameter

IS THERE A DOCTOR IN THE HOUSE?

When costs soar and sales decline, that's the time to call an industrial doctor Just as an abdominal pain warns against the use of a physic and calls for consultation with a qualified physician to determine the presence or absence of acute appendicitis, so does an unusual business condition call for the services of an expert Such experts, generally known as "management consultants," specialize in cost-cutting, standardization, sales advice, and similar procedures which many company management men overlook because they are too close to the woods

Don't get the idea that these management consultants are valuable only to small concerns. Witness the expenditure of $1,500,000 by United States Steel Corporation over a three year period for such services On the other hand, the investment of a few thousand dollars for a systematic study of a wage incentive plan or a market survey may mean the difference between profit and loss, even in a relatively large operation where tradition, sentiment, or simple pig-headedness on the part of company officials may be unseen stumbling blocks

WHAT DO EMPLOYEES WANT?

All too often management tries to guess at the things that employees want, at the things that will make for better industrial relations, for greater output, lower costs, and the like When these things trouble executives, let them go to the right source for the answers—to the employees themselves The National Drygoods Association recently undertook such a survey They asked eight questions of employees and supervisors Here are a few samples from the final tabulation Employees placed first the desire for credit for work that they are doing supervisors guessed that this factor would take seventh place Second, employees wanted interesting work to do, supervisors guessed that this would be third in importance Third in employee preference came fair play and salary increases, this is the element that supervisors placed first Last on the list of worker-preference was job security, which the same supervisors had placed second

Moral If you want to know what a man wants, ask *him* not his boss

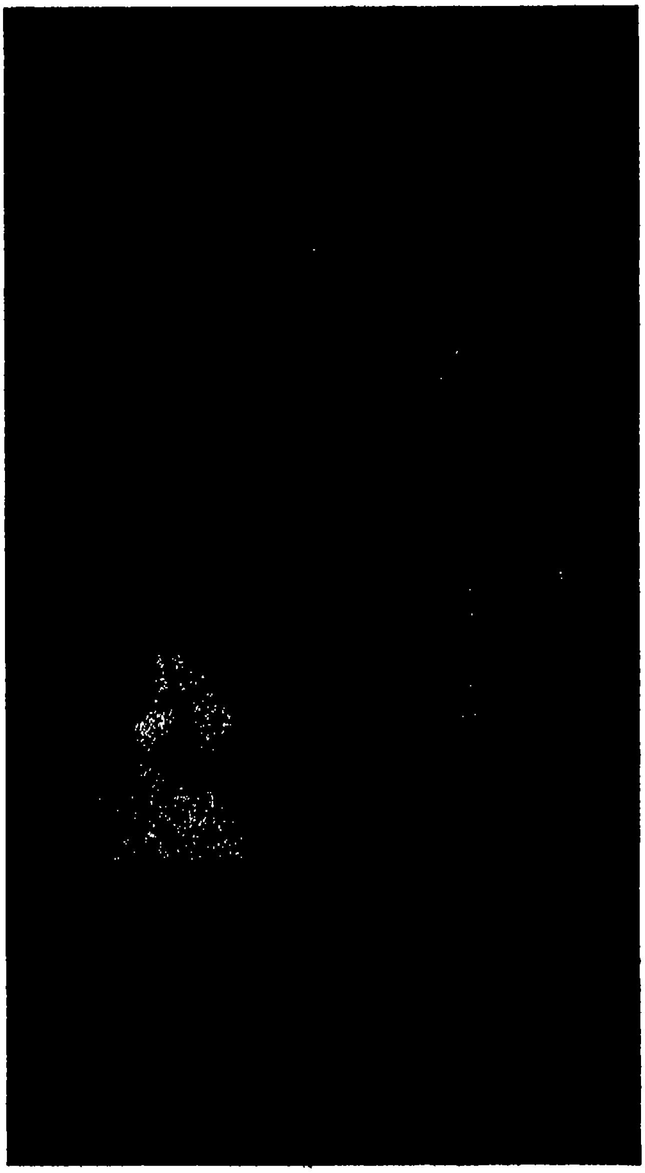
STRAWS IN THE WIND

Increased use of Diesel engines, which offer the greatest thermal efficiency of any proved type of power, is seen as the result of fuel shortages for all types of engines. Wood, oldest structural material used by man, is being subjected to intensive study in an effort to determine causes of decay and precise means of preventing the losses which result, gains will be not only in the preservation of the material itself but also in fewer replacements and in reduced costs of labor in making repairs Radiant heating for homes, still in the pioneer stage but making rapid strides, is now being accomplished experimentally by means of electrically heated ceilings, the current passes through a heating element of conductive rubber sandwiched between two thin layers of plastics Electrical insulation, still much the same today as it was a century ago, is receiving increased attention from chemists, new and improved insulations are needed if high-voltage techniques are to progress.

Scientific American

SEPTEMBER • 1947

ARC WELDING is being HANDICAPPED



"Great and Unnecessary Expense is Being Put on the Manufacturer Using Welding This, of Course, is Paid by the Buyer in Higher Prices No Possible Return Accrues to the User"

Says ***JAMES F. LINCOLN***

President, Lincoln Electric Company

EDITOR'S FOREWORD Some months ago a thought-provoking letter was received from Mr Lincoln regarding limitations and restrictive tests placed upon arc-welded joints, but not on similar joints designed for similar purposes and completed by riveting We decided to publish Mr Lincoln's views but first made intensive efforts to present the subject in debate form, with a representative of the rivet-manufacturing or using industry as Mr Lincoln's verbal opponent Our efforts bore no fruit. But more of this later First, Mr Lincoln's letter

"**ARC WELDING** has been of decisive importance to America Arc welding did more than most other manufacturing processes in the producing of the tools of war during World War II Arc welding has produced a record for reliability in billions of welds, made over many years, that is unmatched by any other manufacturing process, yet arc welding is being attacked in a way which is tremendously handicapping its application, and promises still more to interfere with its future uses

"This attack is aimed not at the process, as such. It is obvious such tactics would fail. The attack consists in throwing suspicion on the process by writing into specifications expensive and impractical tests which have little to do with the excellence of the weld Most of them have to do with infinitesimal variations of no possible importance, but of great cost The attack has already eliminated the economic use of arc welding in many proper applications If continued, it will soon eliminate many others

"We see, for instance, the ruling that welds must be X-rayed, which increases the cost by several times, yet the commercially welded joint is always of greater strength than the parent metal and is tremendously stronger than any riveted joint, where X-raying never has been suggested.

"We see riveted joints which are made tight by caulking This process is accepted without question The resulting undercut is enormous, yet a welding undercut that is infinitesimal is frequently made the reason for rejection of welds

"We see welds chipped out re-welded, and welded vessels rejected because of trifling defects such as infinitesimal porosity either on the surface or beneath, yet parent metal in the same structure with defects much greater, and whose weakening effect would be tremendously more serious, are accepted without question.

"We see welding electrode specifications being written which enormously increase the cost of production with no increase in either the reliability nor in the excellence of electrodes Rivets have no such test to handicap them

"While a welding electrode is tested in every conceivable and nonsensical way, no one suggests any test on a rivet, yet the riveted joint is always the weakest spot in any structure This is never true of a full-sized welded joint.

Much time and expense is used in testing electrode deposit to make sure it has great ductility and the weld is rejected if the ductility is low, yet riveted joints have no elongation and are accepted without question

"The contour of the deposit of a weld is a matter of very close inspection, yet no one examines the contour of any rivet or the hole it only partially fills

"All insured vessels must have their welds X-rayed and any weld is rejected if any infinitesimal defect is found, yet no one X-rays a riveted joint nor rejects it because of the voids between the rivets and the rivet holes which are known to be always present

"Because of the higher elastic limit of the weld metal, there is no load that can be put on a welded

Welded steam pipe in this heating plant is giving satisfactory service, was economical to fabricate

structure in which the weld is of equal or greater section than the parent metal which can affect the weld in any possible way until great distortion of the rest of the structure has taken place Such distortion would make that structure valueless for its intended purpose, yet all this testing and rejecting listed above is made mandatory in many welded structures—never in riveted structures

"Further instances of the same kind can be cited by the scores The examples shown are sufficient for the author's purpose

"Welding over the years has done a more reliable job than the rivets it has replaced That record is conclusive The engineering profession, which relies so completely on welding in so many cases, must recognize and resist this studied attempt to eliminate the arc-welding process The attack has already eliminated the economic use of welding in many structures The success of such an attack on this tremendously valuable method is neither good advertising for the engineering profession nor good ethics for those involved in the attack It is time we dealt with reality"

REFUSAL TO DEBATE—Several invitations were issued by the editor to various people who should be in a position to defend the status of rivets in a controversy of rivets-versus-arc-welding In every case the issue was avoided Typical was the reply of Mr Herman H Lind, President of the American Institute of Bolt, Nut and Rivet Manufacturers Said Mr Lind "It is not in line with the policy of this organization to disparage any other method of fastening, and we do not believe that a debate of this kind could work out otherwise Therefore we will simply proceed along the line we have been following of selling the virtues of bolted and riveted connections"

The editor did not feel that the proposed debate would necessarily involve a disparagement of other methods of fastening A letter to this effect went forward to Mr Lind but remained unanswered

Now back to some other correspondence with Mr Lincoln In attempting to rationalize the reasons why restrictions are placed on arc welding which are not placed on riveting, the editor wrote Mr Lincoln as follows "Riveting is the old-timer and arc welding is the child There is little or no danger that riveting will change the metallurgical structure, whereas arc welding often will do so Then, too, riveting produces 'exposed' joints fully opened to view, arc welding produces what might be called a 'covered' joint For this reason arc welding may be open to suspicion"

Replied Mr Lincoln "I must admit that I do not get the point you make that welding changes the metallurgical structure of steel whereas riveting does not If you mean that the rapid heating and cooling makes a fundamental change in the steel, there is no doubt there is a slight change of no particular importance, but I am under the impression that the heat of a rivet would, to some extent, do exactly the same thing But in neither case would it be controlling to any extent."

ANALOGIES AND TESTS—While the editor was making further unsuccessful efforts to promote the rivet-versus-arc-welding debate, another detailed communication was received from Mr Lincoln It follows

Not a single welded joint in a mile of pipe in a factory steam distribution system showed even a pinhole leak under hydraulic test at 400 pounds gage

"Some time ago I wrote you regarding unnecessary handicaps now forced on the welding process Since that time, I have become even more disturbed.

"Anyone following the standards and discussion covering arc-welding electrodes and techniques cannot help but wonder Here is a process that has been used in billions of cases for every imaginable purpose over a generation, whose record has been almost perfect, yet it is criticized and limited more than any comparable process in all mechanical history The criticism is not because of failure, as there is none The criticism is entirely in the region of theory covering conditions which could never occur in commercial application

"Anyone who views the situation objectively cannot help but wonder whether the people writing such standards and making such researches can possibly be serious

"There is one controlling fact regarding welded structures which, from a practical point of view, makes all of this activity nonsensical That fact is

Although the weld in the test specimen at left had an abnormal amount of undercut, the specimen failed in plate when subjected to a tensile pull of 59,400 pounds per square inch

The welded joint (right) was extremely porous, yet did not yield under tensile test; specimen failed in plate at 62,000 pounds per square inch

Abundant surface porosity in weld at left did not affect the service-strength of the joint; the specimen failed in plate at 59,100 pounds per square inch

this—in the case of mild steel, which embraces more than 95 percent of all the welding which is done, the welded joint is very much stronger and has a very much higher elastic limit than the plates joined.

"Since that is true, the weld can never be used in actual service at anywhere near its point of failure As a matter of fact, in actual application if the welded structure should be loaded to a point which would even approach the elastic limit of the welded joint, or the metal immediately adjacent to the weld, the structure itself would be useless

"Perhaps we can illustrate the matter this way Suppose there is a chain of 100 links, each link being made out of one-inch round, 99 of these links being made of mild steel and one link made of high-strength alloy steel Then suppose the chain were tested Would anyone worry about the chain breaking in the one alloy link? He would not, because every one of the other 99 links would break long before the alloy steel link was even partially loaded.

"Exactly the same thing is true of a welded structure The weld itself and the metal immediately adjacent to it has an elastic limit 50 percent above that of the parent metal and has ultimate tensile strength at least 20 percent greater If the strength of the rest of the structure is sufficient, certainly the weld must be As a matter of fact, structures are designed with a factor of safety so that at its maximum load the structure would not be up to one half of the elastic limit of the parent metal Obviously, it would not be stressed to more than one third of the elastic limit of the weld metal and the plate immediately adjacent to it Using our illustration, why should we worry about the alloy steel link when the mild steel chain is not loaded to its yield point?

"Because of this program of criticism, great and unnecessary expense is put upon the manufacturer using welding This, of course, is paid by the buyer in higher prices No possible return accrues to the user There are countless illustrative cases that could be cited, the following are examples If there is surface porosity, even so much as a little hole on the surface, the weld is rejected. If that same little hole were below the weld surface where it could not be seen, the manufacturer must cut it out carefully and *re-weld the joint*, at great expense, after finding it with expensive X-ray Again, if there occurs slight undercutting at the edge of the weld, the weld must be re-welded and the slight undercut eliminated.

"Perhaps we could understand such rules if they were not made by engineers who obviously know the facts However, all such rulings are made by men who insist they are expert in the profession of arc welding. Hence, the conclusions are not based on ignorance.

"While the accompanying photographs of test samples show facts that are well known to all those who are versed in the art, they are shown again to bring out the obvious facts Here is the proof of all the above statements regarding the efficiency of welded seams with so-called defects Here is porosity carried to the greatest extreme that skill can take it, yet the joint is stronger than the plate Here is great undercut and even laps in the weld, still the plate breaks in tension Not only would such joints be rejected, but if they had 1 percent of these so-called defects the structure itself would be rejected The question naturally is asked, 'Why?'

"It is perfectly obvious that there could not possibly be a riveted joint which could join any of these pieces of steel together in any way which in tension would not break, yet there is no testing of the rivets, no X-ray of the voids in their joint, no elimination of the undercut. Yet we know in every riveted joint that all of these defects are present not only occasionally, but in every case Again we ask the obvious question 'Why accept such defects in a riveted joint and reject them in arc welding with its greater strength, ductility, and soundness?'

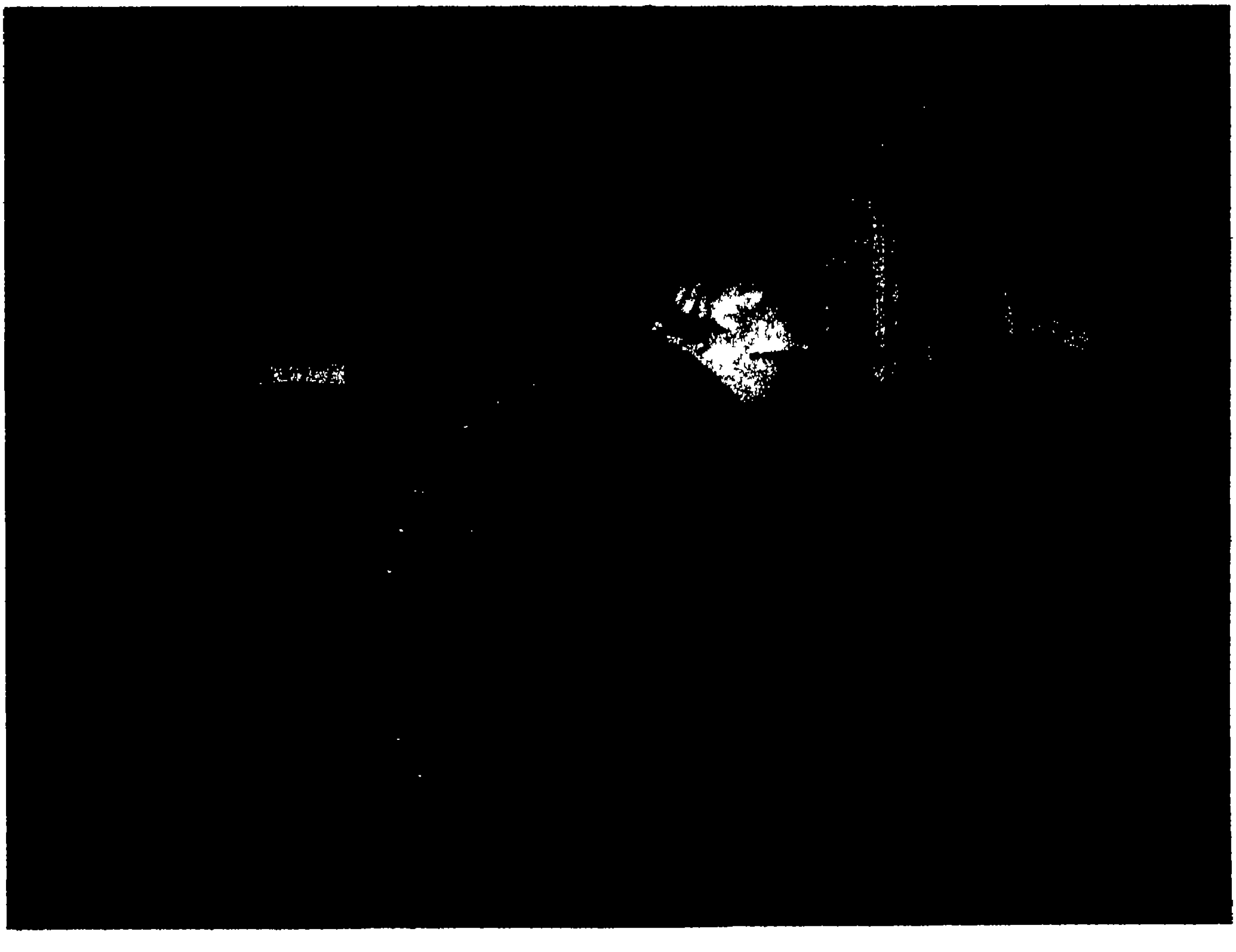
"Engineering has contributed to America's prosperity in an unbelievable way, but I tremble to think what would occur to our prosperity if all engineering were as remiss in its understanding of the problem as is true of many engineers' attitude toward electric welding

"There is no doubt that if the foolish restrictions, which can add nothing whatsoever to the success of any welded joint, were removed, the cost of welding those structures could be reduced by as much as 90 percent in many cases, yet because of these restrictions, concurred in by many engineers, the industry paid hundreds of millions of dollars in additional costs over the years with no increase in safety and no betterment of the product from any point of view

"These same restrictions still stand and are being rapidly amplified There can be no doubt that their presence is not the result of engineering judgment It is impossible to believe that can be true There can be only one reason and that is a studied attempt by some people to discredit this tremendously valuable manufacturing process which contributed more to the winning of the war and to the production of a standard of living than almost any other recent mechanical development Such a program must be stopped"

NO REPLY—Still the editor has been unable to secure authoritative arguments in favor of riveting, answering the forthright statements made by Mr Lincoln Admittedly we have not canvassed the *entire* field, have not approached *everyone* concerned with the process of riveting Perhaps the publication of this correspondence will bring forth some interesting discussion Comments are invited

Fabricating a pressure vessel with the "Shield-Arc" welder at Lasker Brothers' Chicago plant

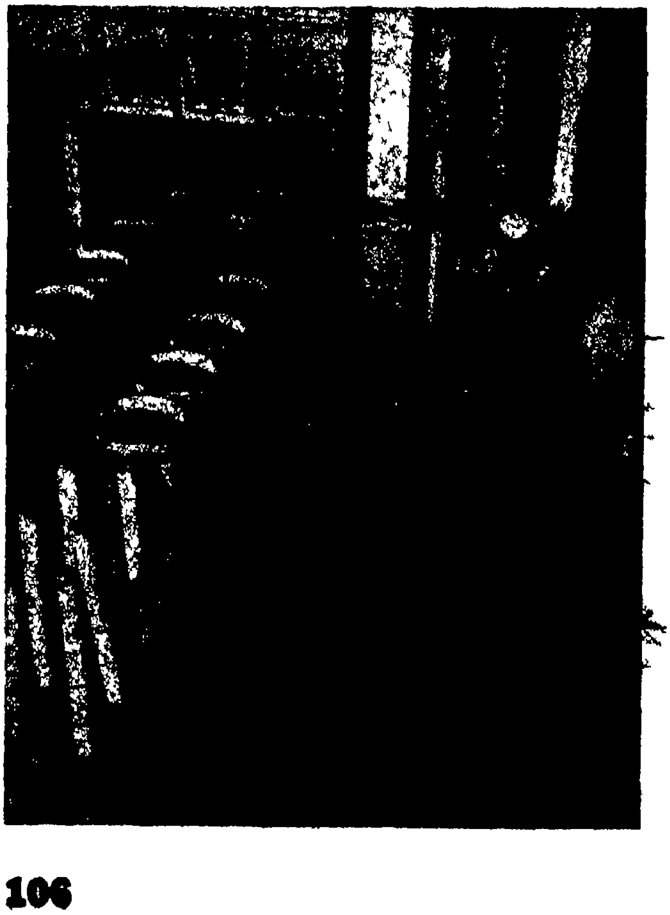


Porcelain Coats on Metal Bases

Research by Porcelain Enamelers and Steel Producers is Aimed at the Development of Even Thinner, Even More Resistant Coatings Which Will Improve Countless Products for Both Home and Industry

By Edward Mackasek
Managing Director, The Porcelain Enamel Institute

Porcelain enameled parts coming out of the firing oven



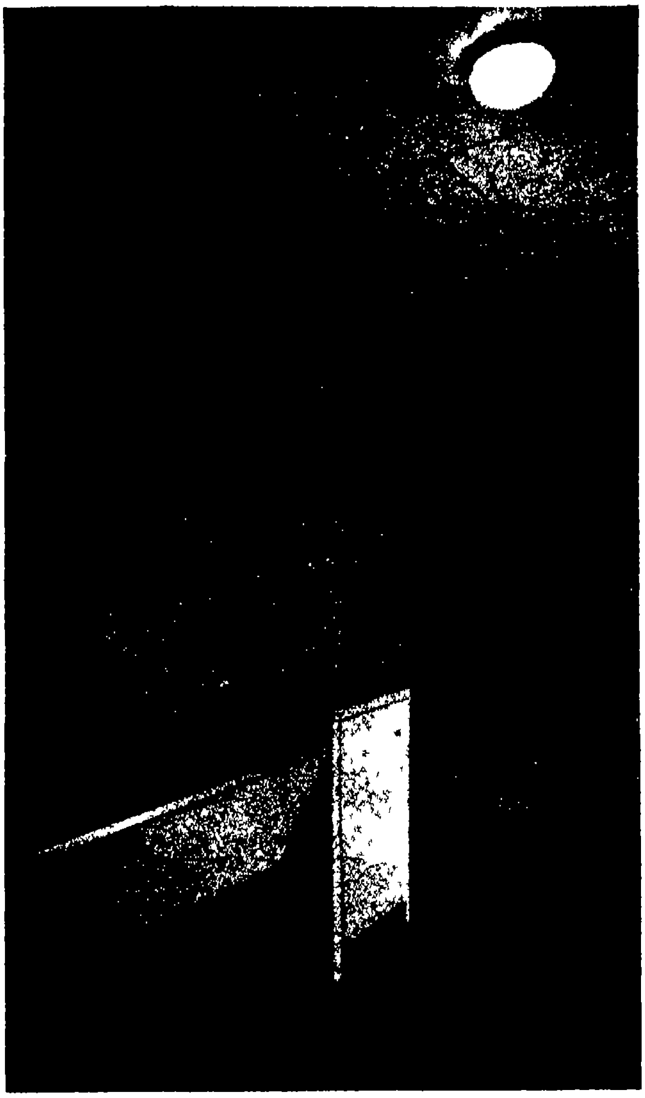
IT MAY seem somewhat paradoxical to say that porcelain enamel has come of age, since it is a material which was well known to the ancient artisans of Egypt, Greece, and Rome Yet it is true in the sense that this surface finish is contributing more and more to our modern standards of living and has become an important factor in many industrial operations

Porcelain enamel is an inorganic, glass-like material, fused to an iron or steel base at a temperature of usually between 1500 and 1600 degrees, Fahrenheit The resulting coat has a smooth, glossy surface and is held firmly to the metal by both mechanical and chemical means

To the ancient craftsman, the value of porcelain enamel lay in the beauty that he could create with it, today, porcelain enamel is usually thought of in terms of the services that it renders Modern research, spurred on in the past few years by war-time necessity, has brought out a wider variety of utilitarian properties of porcelain enamel than were recognized before New porcelain enamels, incorporating these superior qualities, are now available to manufacturers, and it is anticipated that these enamels will continue to broaden their applications for domestic, commercial, and industrial use

So many and so varied are today's porcelain enamels that it is necessary to regard the phrase as the family name of a large group, rather than as denoting a single substance In selecting a porcelain enamel, the manufacturer specifies the condition under which his product is to operate, and a porcelain enamel is selected for this service Thus, enamels may be chosen for resistance to abrasion or gouging, to acids or alkalies, to atmospheric corrosion, or to heat.

IN THE HOME—It is its high resistance to heavy wear and its pleasing appearance, in addition to the fact that it is so easily kept sanitary, that has long made porcelain enamel a favorite for kitchen and bathroom fixtures A newer application of this surfacing is to the exterior of houses, stores, service stations, and so on Here, bright, colorful porcelain enamel can retard weathering, virtually eliminating costly maintenance Roofs, shutters, awnings, entrance hoods, window boxes, and decorative items are also being finished in porcelain enamel. Inside, porcelain enameled clothes chutes will add to the importance of this household utility Porcelain enameled hot water heaters are finding increasing use in the home



And a host of other items are on the designers' drawing boards or coming from production lines—such items as porcelain-enameled parts for fruit juice extractors, electric mixers, and other appliances for the housewife's convenience

IN INDUSTRY—Of even greater importance, however, are the industrial applications of porcelain enamel which have multiplied too, making for better, longer-lasting machines, and overcoming some provoking mechanical service problems

A new type bearing, particularly suited to pumping equipment for corrosives, is entirely coated with acid-resisting porcelain enamel, and can be lubricated with anything that is liquid A deep-well turbine pump, equipped with such bearings, has been successfully handling corrosive oils for five years These bearings have also been adapted to boats, to pumps of many other kinds, and to chemical equipment

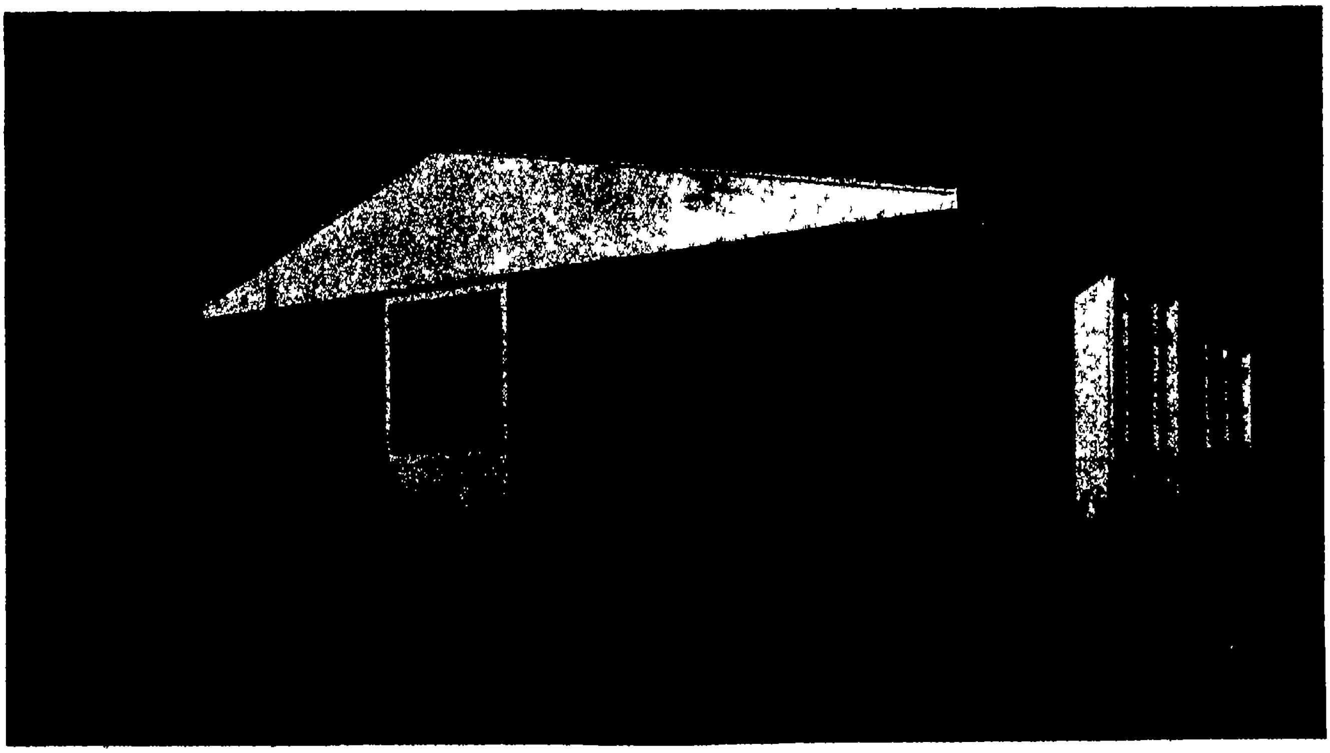
Porcelain enamel coats applied to electric motor parts which are subjected continuously to friction have outworn many other materials tested As a coating for light-metal casting crucibles, porcelain enamel shows possibilities as a refractory And porcelain enamel offers many interesting dielectric properties

During the war the Navy sought a coating or material for submarine exhaust stacks which could withstand both blistering heat and the corrosive action of

In the laundry room, as in the rest of this house, all of the walls and ceilings are of porcelain enamel

This prefabricated house makes extensive use of porcelain enamel for both interior and exterior surfaces

Courtesy Lustron Corporation



• LOOKING AHEAD •

Depreciation of buildings retarded by application of porcelain enamel to exterior surfaces Simpler, more efficient handling of many corrosives Possible solution of high-heat problems in jet engines More effective porcelain enamel coatings at lower cost

sea water Porcelain enamel research produced a special heat and corrosion-resisting coating which handled the job not only on submarines, but later on aircraft and other types of engine exhausts. While primarily a war project, this achievement now shows promise in many applications where both high temperatures and corrosive atmospheres or liquids are a factor Among these are the piping and equipment of oil and gasoline refineries, synthetic rubber plants, chemical and food processing plants, power plants, hydro-electric equipment, corrosive-carrying pipe lines, and many others

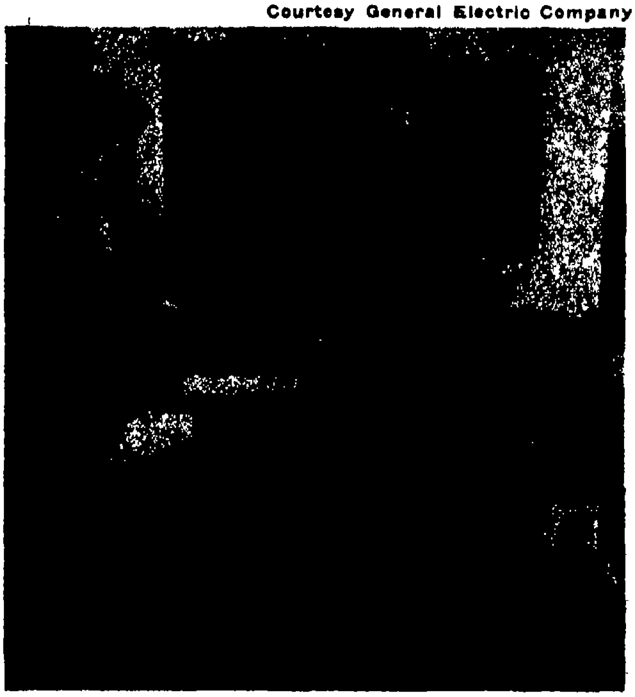
The refractory qualities that can be built into porcelain enamel can be appreciated when it is realized that some new coats running in thickness as low as 002 to 004 inch can withstand exposure to temperatures above 1500 degrees, Fahrenheit Such enamels are able to function satisfactorily even when subject to sudden drops of temperature amounting to several hundred degrees These special refractory-type coats are being explored further to find out whether they can be used on jet turbines where the rapid destruction of the housing metal at the high temperatures of operation is a serious problem

TOWARD THINNER COATINGS—One goal toward which the porcelain enamelers are working is thinner coatings Reducing the thickness of the coatings is desirable primarily because it lowers cost of application and increases serviceability The thinner coating makes possible greater flexibility and impact resistance, thus permitting a wider range of product design

Ten years ago, a porcelain enameling manufacturer regarded a total thickness of 025 to 04 inch as quite satisfactory Today's improved porcelain enamels and improved enameling irons make it possible to establish specifications for ordinary work of 015 inch or less These improvements have been obtained without impairing light-reflectance or appearance In fact, it is probable that much thinner coatings with even higher reflectance will soon be available

Color variations between batches of enamels can be determined by the use of the spectrophotometer

Courtesy General Electric Company



These thinner coatings of improved quality will have increased service life compared with the thicker enamels The chief struggle in their development is to produce them more economically

TOWARD FEWER COATINGS—The usual porcelain enamel application has been three coats—a ground coat or base coat, and two cover coats—each applied and fired individually To reduce the required number of coats has been the objective of much recent research The enameler's fondest dream is to do away entirely with the conventional ground coat, which would mean a vast expansion of porcelain enamel into many new fields. For many purposes the new super-opaque enamels, some containing considerable amounts of titanium oxide, have permitted a reduction in the number of coats

At the end of World War I, the porcelain enameling industry found its operations seriously threatened by the shortage and rapidly increasing price of tin Tin oxide was considered an indispensable ingredient that provided the opacity of white enamels As evidence of the progress which has been made since then, tin oxide is now used very little in the industry It has been replaced by oxides of antimony, zirconium, and, more recently, titanium At the same time, efforts to increase opacity have been paralleled by research to reduce the quantity of enamel needed to provide the required degree of reflectance Titanium opacified enamels are relatively new, but they have created a great deal of interest It is now possible to achieve a high degree of opacity, as measured by reflectance with a light-weight application, in some cases less than one half as much as for other enamels

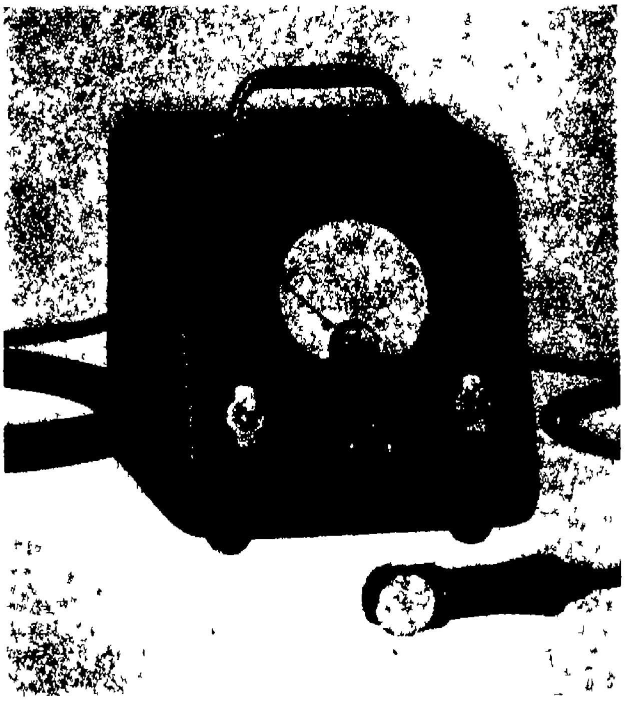
Using a new zirconium-type white cover coat, a number of porcelain enameling plants have been able to speed up their furnace operations, and thus achieve a real economy in operation Usually the ground coats must be fired at higher temperatures than the cover coats, necessitating separate processing for each With the new zirconium type, it is possible for both ground coat and cover coat to be fired on the same furnace chain.

The industry is following with keen interest the work being done to formulate porcelain enamels that will mature or fuse at temperatures lower than the

1500 to 1600 degrees, Fahrenheit, required for conventional types Such low-fired enamels, if feasible, would help products which have been highly stressed by forming operations to hold their shape when subjected to enamel-fusion temperatures

STEEL INDUSTRY HELPS—A vast amount of research lies back of the high-quality iron and steel that go into many products, nowhere is this more true than in the case of objects which will be coated with porcelain enamel

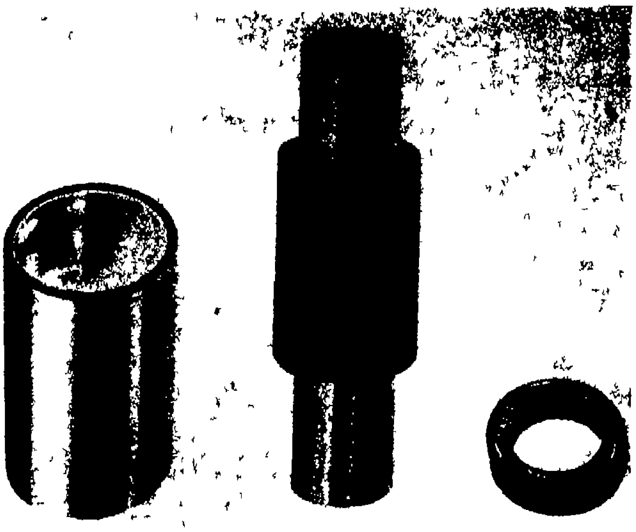
At the turn of the century, most of the metal for porcelain enameling came from England Today, American steel suppliers produce enameling stocks considered the best in the world A porcelain enameler cannot use the ordinary grades of sheet metal. The high temperatures reached in this process demand a metal that can "take it" The steel industry has responded with sheets which have enabled the manufacturers to turn out high quality porcelain enamel products at low cost



Courtesy General Electric Company

With this gage, the manufacturers of porcelain enameled products can check accurately the thickness of coatings

Today the steel companies are working even harder to provide the industry with improved enameling stocks on which porcelain enamel may be applied in one fire without the use of the conventional ground coat. Such new stocks would speed up the production line and lend themselves to thinner applications of super-opaque enamels, permitting thicknesses of 004 to 006 inch instead of present accepted coatings ranging to 05 inch The accomplishment of such a forward step will multiply by many times the various applications of porcelain enamel. It is expected that the ultimate product from such a development will cost less, even though the improved metals and enamels may cost more, since the improvements will provide such great production savings



Courtesy Caldwell Glass Bearings, Inc

Rubber parts in porcelain enamel bearings, when wet, slide over the enamel bearing surface with little friction

STANDARDS ESTABLISHED—Quality control depends upon the availability of methods for the measurement of specific properties In the past decade the porcelain enameling industry, through its trade association, the Porcelain Enamel Institute, in co-operation with the National Bureau of Standards, has developed a series of standard tests to evaluate porcelain enamel properties With these tests manufacturers can now check the quality of the finish on their products These tests have become the basic tools of the research engineer in evaluating the properties of different enamels, and have proved of invaluable assistance to him in his constant search for better formulas They have enabled the specifications writer to establish definite procedures for measuring the level of quality that he has written into his standards

The Porcelain Enamel Institute tests now cover the following properties acid resistance, reflectance, abrasion, impact, and torsion

Porcelain enameled product manufacturers no longer need depend upon human eyesight, with its uncontrollable variations, to judge the qualities of their finishes, mechanical controls are used The thickness of the coating, which bears such an important relation to its service, can be accurately checked to the thousandth part of an inch by a new electromagnetic gage Reflectance is scientifically measured by an instrument called the reflectometer Ability of the finish to withstand hard wear and tear in service can be determined by a special machine developed at the National Bureau of Standards which gives an index of surface abrasion Color matching has been greatly facilitated by a new color analyzer. Thus, guesswork as to quality has been eliminated and standards of known quality can be set up to guarantee any desired performance

BETTER GROUNDS make BETTER FACTORIES

By Edwin Laird Cady

Beautification of Factory Grounds, Considered by Some To Be at Best a Waste of Money, Is Proving Itself a Sound Investment

HIGH ON the activities lists of hundreds of industrial purchasing agents right now are the selection of shrubs, flowers, and trees for the grounds around their factories, and the placing of the 1948 contract for planting and caring for them

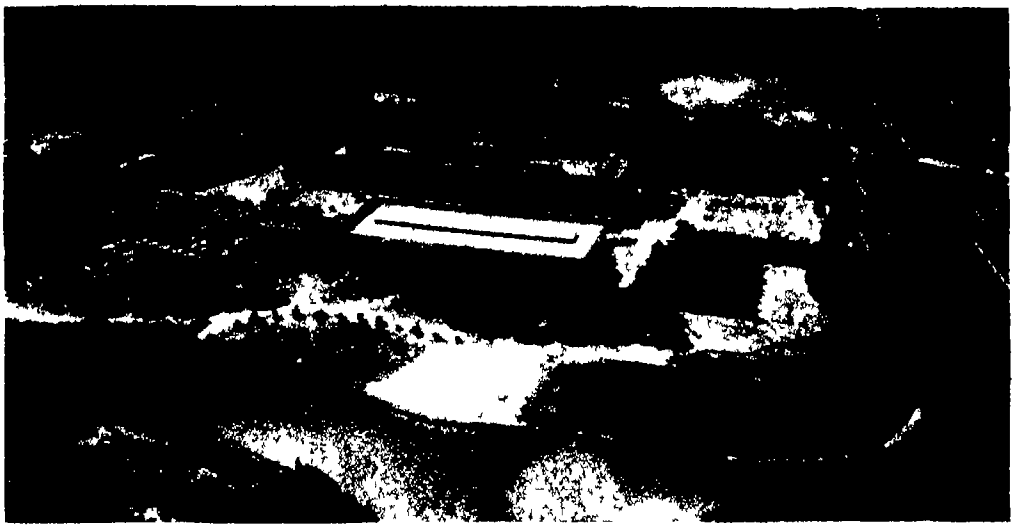
Not very long ago such an activity was considered a show-place stunt, a waste of money, even a form of vulgar ostentation Factory exteriors were supposed to look "practical" But now industrial managements have learned that well-kept grounds have high values And, from companies which have 50 factories to factories which have 50 men, the practice of good grounds-keeping is growing

One of the values is the promotion of safety In a recent survey hundreds of factory managements reported that well-kept grounds are second only to good interior housekeeping as a way of inducing employees to observe safety rules There is something about a plant which is neat and orderly outside and in, that makes the better employees want to be orderly and safe about their machines

The grounds of the Upson Company are of exceptional beauty

A plant which handles a great many bulky steel items thought that good grounds-keeping was impossible The land was needed for trucks and for railroad tracks But the planting of flower beds in odd corners changed this idea Warehouse and materials-handling employees had been "temporarily" piling excess stock in these corners just to get it out of the way All too often the stock had remained there long enough to be damaged by the weather With the flower beds taking up that space, and being tended by a pensioned employee the warehousemen either had to take the excess stock to the shelter where it belonged or else take a tongue lashing from the pensioner and his friends As a result, this company has planted shrubs and flowers in every practical area

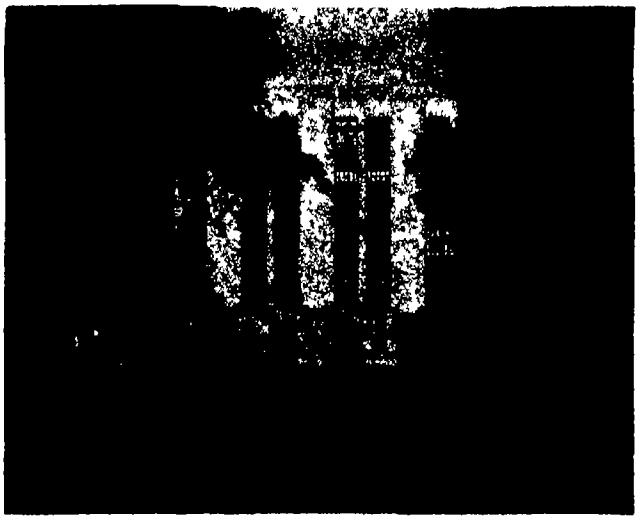
AIDS DUST CONTROL—A company which makes ball bearings and other precision devices found a practical value for landscaping in dust control Originally these grounds had been planted to lawns and



Landscaping at the plant of the Jewel Tea Company, Inc., is not limited to the front of the building (below), but includes a considerable amount of land on all sides of the plant (left)

• LOOKING AHEAD •

More and more stress laid on esthetics in industrial plant design The term "factory town" losing its stigma Results— an upswing in efficiency, safety, and comfort in the plant Better living conditions and higher property values in factory towns



trees because the president refused to have his factory look any less attractive than his home But after the trees had developed and lawns had grown for a year or so, the factory maintenance engineer noted that there had been a profitable reduction in the problem of keeping dust out of the plant during the dry summer months And dust, of course, is one of the worst enemies of precision production

The sales value of good grounds-keeping can be astonishingly high A study which was made to find out which local factory had made the best impression on its community found many of the citizens mentioning plants which were thousands of miles away They remembered these distant factories which they had seen while on vacation tours, furthermore, they had bought goods, invested money, taken other actions for the benefit of those companies

DISPLAYED WITH PRIDE—A maker of kitchen ware, wondering at the influence which its factory gardens seemed to have on sales, found that much of the value came from local townspeople The factory had become a showplace, something which the local people displayed with pride to all who visited them.

Community spirit makes a big difference Cities like Rochester, New York, have so many beautifully landscaped factories that it seems difficult to find an ugly plant there The city of Louisville, Kentucky, awards an annual garden club prize to industries, calls it the Beautification League Prize But in many another town the factory grounds look like dumps

One of these ugly cities is just waking up The secretary of the Chamber of Commerce is doing the awakening He visited a fellow secretary in a distant city and took a busman's holiday in going around to see how the other fellow worked

There was the usual business of persuading new industries to settle in the town He heard the familiar arguments about taxes, concessions, railroad sidings But these discussions were carried on while riding past one beautifully landscaped factory after another, and while going inside to see the neat housekeeping which follows so naturally with a well-groomed plant exterior And he saw that those well-kept grounds created a favorable sales atmosphere just as a well-decorated store will do

Now he is back in his own town and building up the same community picture Two local factories have begun their lawns and other landscaping, while others have made their plans for 1948 Efforts are afoot to have the local horticulturists make a master industrial plan for the town, fitting each plant into the background of homes or fields that surround it

Within a year or so this will be a truly beautiful factory town It will be the only one in its section of a large industrial state And since prospective new industries usually consider several towns within the same general region, the secretary of the Chamber of Commerce will have the sales advantage over all his neighboring communities for a long time to come

Planning the landscaping in relation to a community poses some interesting problems. The Boston and Maine Railroad, for example, likes to create the feeling that it belongs to its communities. It therefore has learned to use only the shrubs that the local home owner might plant in his own lawn or garden, the kinds that will make him "feel at home"

CHECKS EROSION — In the far west, one of the oil companies has a chain of refineries, by-products plants, and service stations, all in a territory where soil erosion by wind and by water drainage is a serious problem. Shrubs and other beautiful plants of soil-holding varieties are therefore planted on an experimental basis around all the company buildings New varieties are tried every year, together with the kinds which have proved themselves Employees are encouraged to learn about these plants and to explain them to any callers who express interest.

High minded as this procedure may seem, the company also is protecting its own pocketbook. Soil erosion does not have a good effect upon the sale of gasoline and of other products in any territory

This company is one of hundreds which try out new varieties of shrubs and plants, talk about them in their company magazines, take photographic records, then make up combination orders so employees may have the advantage of bulk prices in beautifying and improving their own homes Behind this procedure is the idea that good housekeeping and safety practices begin in the home, that what the employee practices in the upkeep of his house he will follow in the protection of his place of work.

The actual buying and selecting of the shrubs is a careful procedure. For new factories it may be left to the architect. For older plants the horticulturist may be called in But many managements prefer to have the selecting and planting done by employees who follow gardening as a hobby

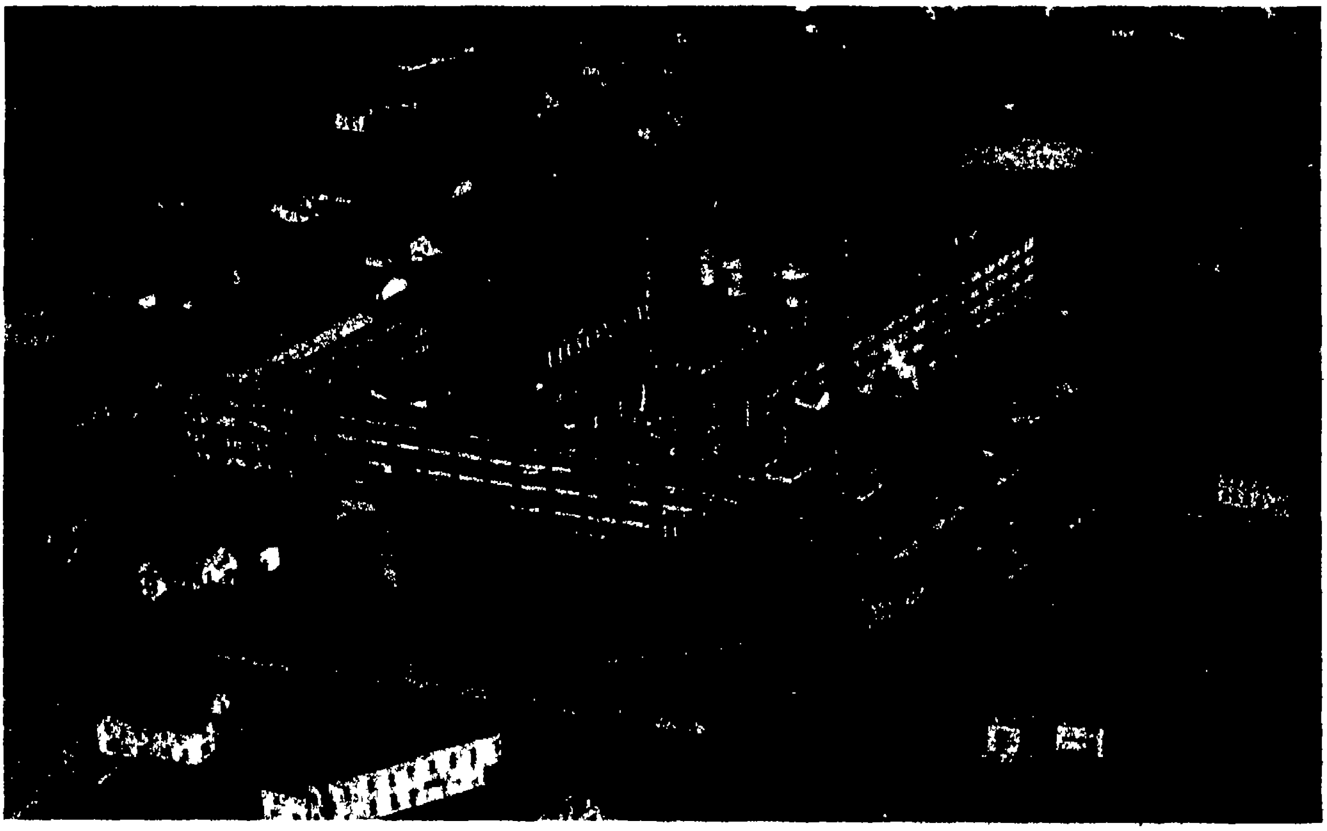
Some grounds practically are "engineered," the nurserymen being required to specify the height, width, and rate of growth of shrubs which they will plant in specified locations This procedure is followed especially when one of the functions of the vegetation is to keep down the summer dust problem, and the landscaping will include many lawns and low shrubs which will be kept well sprinkled so that dust which strikes them will adhere until rain washes it to the ground

Purchase contracts often include specific intervals at which the nurseryman or other supplier is to spray the plants Or where a single contract covers many branch factories and buildings, the contract may call for instructions to be mailed to the local managers at specific intervals

A few factories plant rose bushes and other blooms But the great majority stick to evergreens, shade trees, shrubs, lawns, and a scattering of perennials

This last angle of making sure that the factory landscaping involves the lowest maintenance costs is proof that the plantings serve practical purposes and are not mere hobbies of management Factory exteriors are being engineered for beauty because such beauty is good management

Landscaping at the Hoover Company plant



INDUSTRY GETS Nosey

By D. H. Killeffer

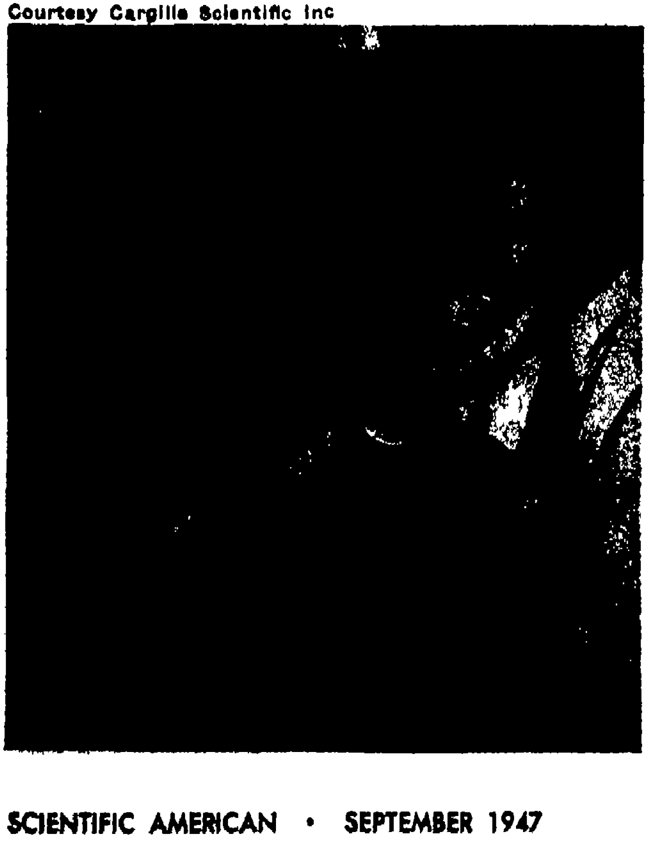
The Science of Odors Is Still in Its Infancy, With Its Greatest Potentialities Yet Unknown But Already Such Practices as Deodorizing, Masking of Odors, and Faint Perfuming Have Achieved Much in Extending the Utility and Salability of Many Products of Industry

Much has been made of industry's discovery of what women have always known—that good odors powerfully promote good will Like many another simple and obvious fact unearthed and adopted by big business, this one is rolling up an impressive record of consequences on industry's several balance sheets Furthermore, these consequences often appear in greatest weight and profusion in the most unlikely places

And yet these are only beginnings So far, the ages-old arts of perfumery have hardly more than suggested the possibilities inherent in the precise control of odors and flavors As an art, the preparation and compounding of odors is well advanced, industrial applications of the art are proving useful and profitable, but the science of odors and flavors and the relations between causes and effects in this vast domain of the chemical senses remain unsatisfactorily explored and imperfectly mapped Not only is the comparatively little that has been done in this field of odor control yielding fabulous returns, but the prospect is clear that rich opportunities awaiting exploitation lie in yet unreported researches, and in many which have not yet even been started! Obviously, it is worth looking into

The Crocker-Henderson system of odor classification consists of comparing the specimen's odor with those of 31 established standards

Courtesy Cargille Scientific Inc



Psychological effects of odors are potent almost beyond belief The powerful and universal attraction of the odors of the kitchen—baking bread, frying bacon, broiling beefsteak, and boiling coffee—leaves no room for argument At the other end of the scale, the tremendous repulsive force of the odors of putrefaction and of the chemical weapon of the skunk is equally irresistible, if opposite in effect. Between these extremes every shade of intermediate feeling is stimulated by odors, faint or strong, possessing individual or general associations, and calling up memories coupled with every degree of pleasure or revulsion Here lies the power of odors

OIL DEODORIZED—Industry has lately learned this Like many another equally obvious improvement, this one has lain in industry's path, to be stumbled over repeatedly Decades ago, highly malodorous petroleum from certain fields was found to contain certain types of sulfur compounds, and these proved responsible for the "skunk" which drove away possible buyers When Herman Frasch discovered the effectiveness of metallic oxides in removing this sulfur by chemical action, he not only "sweetened" the oil by destroying its odorous constituents, but he also brought into the market vast new supplies of oil from Canada, Ohio, and subsequently from other fields Sales resistance, extremely high so long as the then important kerosine, or coal oil, carried a pervading stink, vanished when the new product had none

This has always been a powerful tool for creating good will for industry—to remove impurities causing the unpleasant odor of a product It effectively cures many cases of industrial halitosis An offender even so notable as carbon bisulfide, with its characteristic stench of rotten eggs, becomes pleasantly ethereal when freshly distilled over caustic alkali! Steaming,

Courtesy Givaudan Delawanna, Inc

When an aromatic is sniffed from a blotter, it is easier to detect variations in odor as the perfume dries

• LOOKING AHEAD •

The study of smells gaining the stature of an exact science Odor taking on importance comparable to that of color in product design Research revealing the now-unknown whys and hows of odors Complete and accurate control of product smells

plus the use of adsorbent earths or carbon, effectively sweetens fatty oils and puts many common oils, cottonseed for instance, into the salad-oil class when ordinarily their odor and taste, which are closely related, would doom them to the soap kettle or hydrogenation plant Today, even castor oil is refined to practical tastelessness, although its objectionable oiliness remains

Unfortunately, many industrial products possess inherent smells of greater or less intensity and unpleasantness, and these cannot be purified away The vulcanized rubber goods—automobile tires particularly—of a decade ago or so past gave off an effluvium wonderful to smell—if your stomach could stand it That smell was apparently a natural and inescapable result of the vulcanization of rubber, at least it was so considered until rubber manufacturers and perfumers got together on it. Then things began to happen By slight modifications of manufacturing techniques, rubber makers reduced the odor of their product a little, but it remained for the perfumers to mask the rest by suitable additions of their own

The industrial technique of masking one odor by adding another is at least half a century old, but it is still much misunderstood, and has only lately been re-discovered by industrial psychologists as something new to them One must carefully distinguish between the mutual blocking-out of two different odors and the mere overpowering of one smell by a stronger one This latter characterizes many of the household products—based on cresols, naphthalene, and the like—designated as "disinfectants and deodorizers" which not infrequently leave odors as strong as, and barely less objectionable than, those they destroy Their purpose is primarily germicidal, and the odors they kill are microbial in origin

It is also necessary to distinguish between the mutual masking of odors and their destruction by chemical reaction Alkalies will absorb and chemically neutralize hydrogen sulfide, potassium permanganate, a powerful oxidizing agent, readily destroys most

Such stills as this are used in the manufacture of many synthetic aromatic chemicals for industry

Courtesy Givaudan-Delawanna, Inc

organic odors by chemical reaction, and we have already mentioned the removal of "skunk" from oil by chemical combination with metallic oxides. These are strictly chemical destructions of the odorous compounds, they differ essentially from the neutralization of one odor by another without destruction or change of either.

SMELLS BLOCK EACH OTHER—The effect resembles nothing so much as the interference of two out of phase light waves, or the beat produced by two musical tones of slightly different frequencies. It is certainly not unexpected that odors behave similarly.

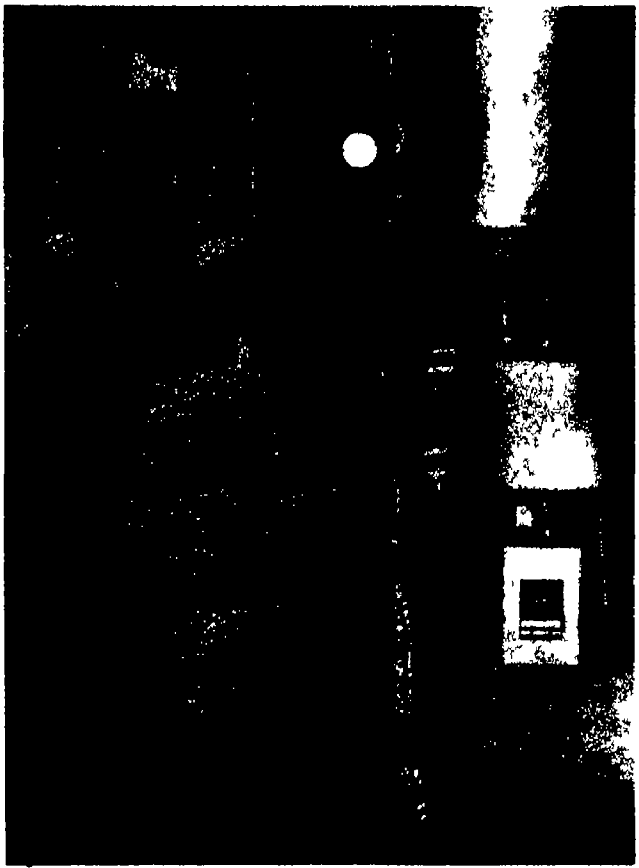
Utilizing this effect, perfumers are sometimes able to render highly smelly products virtually odorless even though they may contain substantial added amounts of an odorizer in addition to that inherent in them. Balsam tolu, for instance, can largely offset the disagreeable odor of vulcanized rubber—neutralize it as complementary colors offset each other.

The masking effect constantly arises to plague the perfumer. In making his various products by mixing a number of ingredients to yield an odor combining those of the several constituents, not infrequently he finds that some of the known additions to the mixture seem to have vanished completely for no evident cause. Actual analysis of the mixture will show that no chemical change has destroyed or altered the original constituents. Obviously, their apparent disappearance is only the masking of one odor by another.

Industry, too, is finding substantial values in compounds possessing odors which are powerfully disagreeable to insects, for example, but which are quite unperceived by the human nose. Ethyl-hexane-diol effectively repels mosquitoes, even the ravenous ones of the South Pacific, by what seems to be an odor disagreeable to them, yet the compound is practically odorless to human noses. Undoubtedly, a whole family of odorous substances of this kind exists, possessing scents which—like ultra-violet and infra-red light, and like supersonic sounds—are outside the range of perception by our human senses. Disagreeable odors *per se* also possess high value, for instance, as warning agents in odorless natural gas to give the alarm in case of leakage.

As has been noted, industry is finding these facts valuable in the extreme. Faint amounts of odorous stuffs added to products of many kinds from laundry soap, lubricating oils, printing ink, and rubber goods to lingerie, woolens, cosmetics, and paints make them more pleasant and acceptable, often (and usually) without imparting to them even the suggestion that they have been perfumed. Although the percentages added in this way are infinitesimal, the total quantities of odorizing materials so used already reach a staggering value beyond $50 million per year.

KNOWLEDGE IS SCANTY—Yet we still know almost nothing about odors and why they are. Three recent books on the subject, "The Science and Art of Perfumery" by Sagarin, "Flavor" by Crocker, and "The Chemical Senses" by Moncrieff, provide together a fascinating survey of this field. But when one has read them all (and anything else he can find on the subject), he is impressed more, perhaps, by the gaps in our knowledge than by what we know.



Courtesy Givaudan Delawanna, Inc.

From these Zanzibar cloves is prepared vanillin, which has a sweet, chocolate-like odor

Only lately have systems appeared for scientific designation of odors, for instance that of Crocker and Henderson, which give us more exact terms than the customary comparisons (onion-like, flowery, ethereal) to use in describing odors. The Crocker-Henderson system involves the use of a set of 31 carefully selected and graduated standards. By comparing a particular odor with these standards, its several elements can be evaluated and the whole then assigned a number of four digits. From this number the odor can be practically duplicated at any time. The standards are prepared from highly purified chemical compounds so that they too can be readily described and duplicated. The principal value of such odor standard comparisons is in the control of the odors of commercial products in regular production.

Still the number of questions we cannot answer about odors we cannot describe is immensely impressive. What makes a chemical compound smell? How is chemical constitution related to odor? How are odors themselves characterized? What properties of two odors allow them to mask out each other? What characteristic of an odor makes it objectionable to an insect or to an animal but not to man? Are the differences between pleasant and unpleasant odors purely psychological? These and a thousand more vital questions remain puzzling, they supply bases for many broad and penetrating researches, which will some day yield answers of immense value.

Mass-Production WIRING

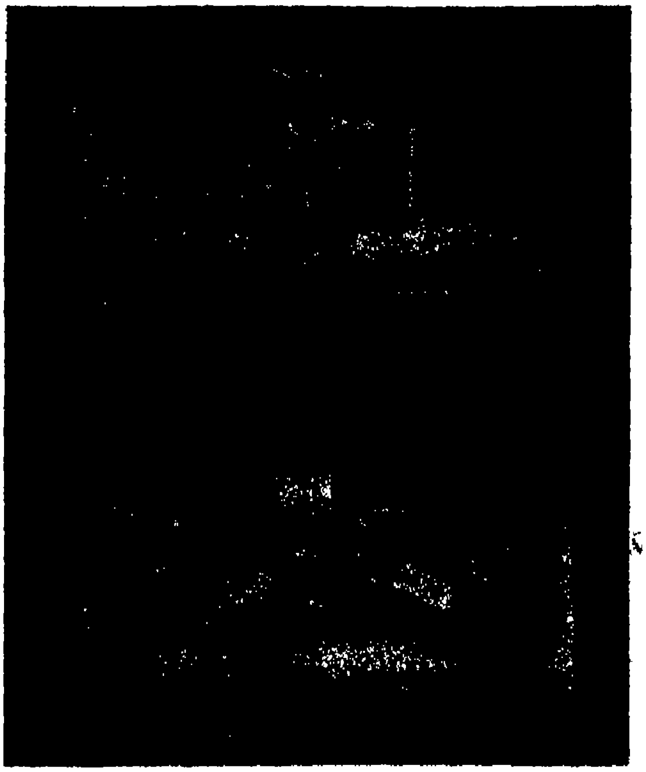
Electronics, Which Has So Greatly Aided in Speeding Production in Many Industries, is Only Now Beginning To Rid Itself of Its Own Wasteful and Antiquated Assembly Methods Mechanized Wiring Techniques Promise to Bring True Assembly-Line Methods to the Manufacture of Electronic Equipment of All Types

By Vin Zeluff
Associate Editor, ELECTRONICS

GREATEST single factor in the total labor cost in the electronics industry is that required by hand operations—a strange condition in this day of electronically controlled automatic machinery and other labor-saving devices This is especially true in the tedious manual assembly and connecting of wires between various components that make up a piece of electronic equipment

Depending on the number of tubes and their circuits, the average radio receiver contains from 100 to 300 soldered connections Modern television receivers have upwards of 400 connections, and industrial electronic equipment varies from about 30 for a simple one-tube relay unit up to several thousand for more intricate, multi-tube equipment In most cases, all of these connections are made by hand but a number of ways of forming several circuits or circuit components simultaneously are now coming into use

The tangle of wires and circuit components in the hand-made receiver (below) is reduced to neatness and order when the Franklin stamped wiring is used in an identical model (above)



PRINTED WIRING—The printed circuit was first developed by the Bureau of Standards as a solution to the space problem in the much-publicized proximity fuse This technique, in which paths of printed silver or silver oxides are used in the place of conventional wiring, has undergone many refinements since the war, and recent announcements from the Bureau have described several miniature radio receivers and transmitters operating in the VHF band in which printed silver "wiring" has been used

The first commercial application of the printed circuit is a complete coupling unit, called the Centralab Couplate, used in audio-frequency amplifier stages The two resistors in the plate and grid circuits, and two condensers—the plate by-pass and the coupling condenser—are printed on one small insulating plate Purchased by a manufacturer of electronic equipment as a complete unit, only four soldered connections are needed to incorporate it into the rest of the circuit, instead of the usual eight or nine required when each component part is mounted and wired individually

Such units cuts materially the assembly time of electronic equipment, in addition to lowering the possibility of errors in wiring And the reduction in the number of soldered joints means more efficient circuits

STAMPED WIRING—Another method of forming many circuits simultaneously is the stamped wiring technique, in which metal strips are stamped or die-cut into a pattern that conforms to the electrical connections This technique, originated by A W Franklin, president of The Franklin Airloop Corporation of New York, appears applicable to mass-production methods, since one basic unit can be turned out for many manufacturers Alterations in the basic unit are readily made by means of dies, so that 90 percent of the wiring within the average electronic device can be stamped out. Most component parts may be connected to the wiring in one operation by dip or induction soldering. Substantial savings in labor, material, and in final adjustment are probable

• LOOKING AHEAD •

More compact, more shock-resistant electronic units Extension of mechanized wiring from radio sets to house wiring, switch boards, and other standardized electrical equipment Servicing problems simplified Costs lowered and circuit uniformity raised

Stamped wiring starts with a thin sheet of insulation having a series of parallel metal strips running in a horizontal direction on one side and a series of vertical conductors on the other side Connection between horizontal and vertical strips is accomplished by punching through the insulating sheet between the conductors, and inserting an eyelet or pin

For connecting a component to a single horizontal or a single vertical conductor, an eyelet or pin may be punched into the selected metal strip at a point where it will miss the metal strip on the reverse side Where breakup of a single conductor into several conductors is required, the strip may be cut at one or more points along its length

Electronic circuit drawings consist essentially of horizontal and vertical lines with cross-overs and interconnections Stamped wiring consists of horizontal and vertical metal strips with the insulation between them constituting inherent cross-overs, and eyelets, rivets, or some other type of fastening providing the connections between strips Thus the transition from schematic to stamped-wiring drawing may easily be made Location of eyelets, points at which conductors should be cut, and placement of parts are easily predetermined

HOW APPLIED—A typical stamped wiring deck developed for a five-tube table-model radio receiver having a conventional circuit is made as follows

Sheets of Bakelite punching stock, similar to that used in the manufacture of wafer-type tube sockets, are sheared to three by nine-inch size

A roll of five-mil pure electrolytic-type oxygen-hydrogen-free copper, tinned on both sides, is coated on one side with United States Rubber Company's Kotol thermoplastic cement

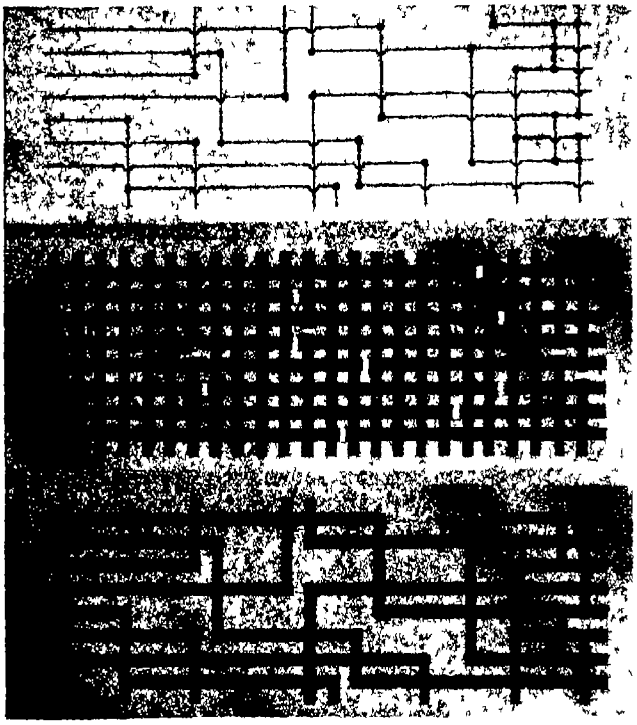
Both the insulating sheet and the copper are fed to a 150-ton automatic toggle press containing a shearing and forming die The die cuts the copper into metal strips 5/32-inch wide, with equal spacing between strips, and presses their edges and ends 3/1000-inch into the insulation The die is heated electrically to 230 degrees, Fahrenheit, and softens the insulation sufficiently to lock the conductors securely in place The heat simultaneously sets the thermoplastic cement so that the material strips are both cemented and mechanically locked to the insulation

The press turns out 20 sheets per minute with metal strips on one side (Metal strips may be placed on both sides at once by using upper and lower dies)

The sheet goes next to a punch press where all

Receiver wired by spraying metal through a stencil into grooves in plastics panel (left) was manufactured in a fraction of the time required by the hand-soldered model (right)

Courtesy Metallizing Engineering Company, Inc



With the schematic drawing (above) as a guide, plastics panel (center) is marked where rivets will be driven (circles) and strips cut (white rectangles). After the stamping operation, the excess metal is removed, leaving the finished circuit (below)

holes for eyelets and pins are knocked out in a single operation. The holes in this particular case are 0.096 inch in diameter, taking pins similar to those used in the manufacture of tube bases. In still another press, eyelets and pins flow from hoppers through feeder tubes to holes in the sheet and are clinched in place. Heating by conduction or induction may be used to solder conductor and eyelet together.

The leads from condensers, resistors, and coils are dropped into eyelet or pin holes in the stamped wiring. This may be done also by the hopper method. Most component parts are placed beneath the sheet where they are soldered in place by the induction method in one operation. Other components, such as tube and transformer sockets, are inserted on the top of the sheet and the sheet is then installed beneath a metal chassis which has cut-outs through which tubes and transformers may be inserted from above. A self-tapping screw in each corner of the sheet holds it in place beneath the chassis.

The tuning condenser, loudspeaker, and controls are mounted on the metal chassis by conventional methods. Leads from these are pushed down through chassis cut-outs to connectors, or soldered directly in the circuit.

Receivers made by the stamped wiring technique perform quite as well as conventionally-wired sets with respect to sensitivity, selectivity, and fidelity. Final adjustment of circuits in production should be materially simpler than in sets where conventional wiring is used, since wiring stamped out by a die will not vary from set to set.

Exact cost figures for such methods must wait until a sufficient number of units employing stamped wiring are manufactured to permit accurate accounting, but it has been estimated that it will be possible to supply stamped-wiring sheets for five-tube table-model radios, with tube sockets built in and ready to receive component parts, for about twice the present cost of the tube sockets alone.

SPRAYED WIRING—Still another new method of mass-forming wiring is known as Spraywiring, which is a method of forming electrical circuits by spraying metal into grooves in an insulating panel. The technique involves cutting a stencil to coincide with the wiring design of the device to be produced. This stencil is placed on a panel and sandblasted so that grooves are formed in the panel. Metal is sprayed through the stencil into these grooves, and remains when the stencil is removed.

The metals sprayed may be copper, aluminum, or silver, with plastics, ceramics, glass, and wood among the suitable insulating material.

The stencils are made of a special masking tape, adhesive on one side, and hard enough to protect the covered face of the insulating panel from the effects of sandblasting and metallizing. Stencils made from the tape are die-cut in continuous strips.

Vacuum-tube sockets, condensers, and other parts are assembled on a panel prior to sandblasting or metallizing, with their contacts placed so that they will be in the proper grooves. The contacts are metallized into permanent connection with the circuit when the panel is sprayed. As in stamped wiring, conductors may be applied to both sides of the panel, and the conductors on opposing sides can be connected by metal eyelets, insertion of eyelets being done prior to sandblasting or metallizing.

Thickness of the metal deposited by spraying is at least 0.005 inch. If insulation of a conductor is required, suitable insulating material can be applied by spraying, dipping, or brushing. Since the circuits are actually imbedded in durable insulating material, they are inherently strong, and not easily damaged.

The Spraywiring method is adaptable to the manufacture of many types of products which embody wiring. According to Spraywiring Laboratories, Inc., it can be used in producing the circuits of a tiny hearing aid, or the basic wiring of a prefabricated house, in addition to its application to commercial and industrial electronic circuits.

The process is completely automatic and continuous in flow. The plastics base pieces are fed into the apparatus and a complete chassis is turned out every 20 seconds, after spraying, milling, lacquering, and testing. Each stage of the operation is electronically controlled, and if any one process fails or lags, all other stages up to that point are stopped.

All of these mechanized wiring techniques are in their infancy, but they hold promise of great and sweeping changes throughout the electronics industry. They signal the approaching end of the antiquated, time-consuming hand operations which have long held down production rates. They will bring with them true mass production, with no danger of impairing quality. And they will greatly aid the manufacturers of electronic equipment in the struggle common to all industry—the struggle for a better product at a lower cost.

Expanding Fields for Expanded Plastics

By Charles A. Breskin
Editor, MODERN PLASTICS

Rigid or Non-Rigid, Cellular Plastics Have High Strength-Weight Ratios and Many Possible Applications, Especially if Prices Can be Made More Competitive

THE WAR gave this country a number of new plastics materials and techniques But it left unsolved many of the problems that govern the application of these materials and techniques to the civilian market

One of these is the group of materials known as expanded plastics, developed largely as the result of the shortage of balsa wood during the early days of World War II

These expanded plastics are either plastics that have been made porous by one of a number of methods, or combination plastics and paper or cloth materials processed so that they take on a cellular, or honeycomb, structure They may be rigid or nonrigid They are used largely as a core material Originally, their primary use was in the construction of military aircraft, where they were employed for their high strength-weight ratio (as was balsa wood), but they seemed to labor under a number of disadvantages when the time came for conversion to civilian uses

It remained, then, for plastics materials manufacturers and processors to refine the materials and techniques already developed, and to develop new materials and handling techniques to meet the requirements of all the applications that seemed possible for expanded plastics in the civilian market The range of these possibilities is wide, covering as it does such diverse items as boat hulls, decks, and bulkheads, toys, luggage, gift packages, ornaments, refrigerators, shipping containers, partitions, prefabricated housing panels, aircraft components, buoys and floats, all types of sandwich structures with core materials, and thermal, electrical, and sound insulation

HOW THEY ARE MADE—Perhaps the best idea of just what expanded plastics are can be had from a description of six methods of production

1 The plastics chosen for the work—cellulose acetate, polystyrene, phenolic, and so on—while in a condition of low viscosity is made into a foam by mechanical agitation, with or without the use of foaming agents When solidified, this foamed mass retains its porous structure

2 The selected plastics substance is manipulated into a soft dough-like condition, then expanded into a somewhat porous substance by blowing air uniformly throughout the plastic mass

3 A gas, or a mixture of gases, is dissolved in a soft plastic mass under relatively high pressure Upon release of pressure the mass is made porous by the expanding gas Hardening fixes the porous structure

4 A soluble solid is incorporated in the plastics After molding, this solid is leached out by solvents

5 A fibrous or other bulky constituent is mixed with a binding substance to produce a porous product In some cases, thermoplastic fibers are employed in bulky fibrous mats in which the individual fibers may be bonded together by action of heat or solvents

The expanded polystyrene "snow ball" provides a novel, attractive package for the perfume bottles

6 A plastics material, or a resin-impregnated paper or fabric, is formed into a structure whose geometry favors low apparent specific gravity Small tubes, grids, or hexagonal cells may be arranged to produce a very bulky product.

APPLICATIONS ARE BROADENING—One of the best indications that real progress has been made in the diversification, in the handling, and in the economic phase of expanded plastics is the adoption by the Frigidaire Division of General Motors Corporation of polystyrene foam as the inner liner for commercial ice cream cabinets This new product is an application that might be regarded as an opening wedge in a potentially great market for expanded plastics—including household refrigerators and freezers as well as industrial and commercial units

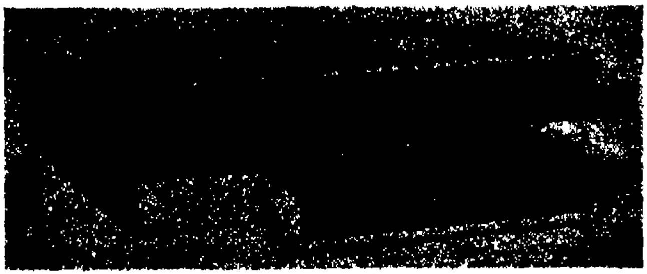
The material's use in airplanes has grown by leaps and bounds In this instance, improved fabricating techniques have contributed the most to the growing volume Today, the Glenn L Martin Company uses phenolic resin impregnated honeycomb structures for bulkheads, partitions, and flooring of its latest planes, the floor of one plane alone using 240 square feet of the material, and such other uses as in the wing sections of these planes, luggage racks, instrument panel bases, and interior doors must alo be included

Even bigger than the aviation field is that of building, where the plastics core material has made a beginning as the filling of a sandwich with aluminum sheets outside And there are boats to be considered Already a one-piece hull has been formed from honeycomb core with a laminate surfacing, this field would seem to offer many opportunities to the suppliers of expanded plastics

Luggage is yet another market where this type of plastics material has been tried There is, too, a wide array of ornaments and gift packages that can be made from the foamed polystyrene

Each of the above mentioned outlets for expanded plastics can benefit from one or more of the outstanding characteristics of these materials which include low density, good electrical and thermal insulation properties, mechanical strength, and buoyancy Furthermore, experience indicates that a variety of properties may be achieved in the sandwich type structure It is possible, for example, to accentuate any desired feature such as structural strength or sound attenuation, or it is feasible to develop a material having a variety of balanced characteristics

Honeycomb core material is strong and rigid, with very low apparent specific gravity



Courtesy General Motors Corporation

The insulating material (see cut-out section) employed in this ice cream cabinet lid is expanded polystyrene

TYPES OF EXPANDED PLASTICS—Each form of expanded plastics, however, has its special advantage and its outstanding characteristic which best fit it for certain types of applications

Expanded polystyrene Extremely light and with unusual thermal properties, expanded polystyrene is moisture-resistant, has low density, and is pleasing in appearance The first three characteristics explain its selection by General Motors Corporation for ice cream cabinet insulation the last—attractive appearance—was the reason for its selection as a packaging material and as a base for Christmas tree ornaments This same quality should attract those interested in window and counter displays, stage and motion picture properties, and toys The boating field should find use for it because of its moisture resistance and buoyancy

The physical structure of this material consists of a mass of small sealed cells It is the continuous wall of these individual cells that prevents water permeation and freezing within the structure and insures the retention of the expanded polystyrene's efficiency as an insulation material

Currently, this material is available in the form of boards several inches thick, and varying in lengths and widths A board of this kind can be easily shaped by conventional wood-working equipment, and may be bonded to itself, wood, metal, or other materials by available adhesives and cements

Cellular cellulose acetate Possessing excellent thermal insulation properties and temperature stability, this material has the advantage of being easily formed into rather complex shapes For instance, it may be hot-formed at temperatures in the range of 195 to 200 degrees, Fahrenheit, or it may be formed after soaking in water Further, when properly prepared and laminated on one side, the material can be bent with its laminated face on the convex part of the curve All of this suggests possible outlets for the material in refrigerating and insulating applications

Produced by extrusion in strips with a rectangular cross section, cellular cellulose acetate is an unoriented multicellular form of cellulose acetate It is available in four ranges of density, varying from four to eight pounds per cubic foot The secret of its temperature stability lies in the absence of any plasticizer The extent of this stability is shown by the fact that mechanical properties at −70 degrees, Fahrenheit, approximate 80 percent of the corresponding properties at room temperature

Expanded phenolic resin Differing markedly from both foamed polystyrene and cellular cellulose acetate, expanded phenolic resin is produced to the desired shape by being foamed in forms of plywood, thin sheet metal, or glass, made to the desired dimensions, rather than being worked with tools from a strip or block The rise of the phenolic resin foam in the forms occurs within a few minutes after the resin has been activated

Its outstanding properties include thermal insulation and acoustical characteristics Further, expanded phenolic resin is fireproof, fungus-resistant, and non-melting Though it will absorb water unless protected by a moisture- and vapor-proof barrier, the resin itself is unaffected All of which makes it suitable as a core material for sandwich structures of high strength and low weight such as those used in aircraft construction and luggage

Honeycomb construction This material, which has been successfully employed as the core in laminated structures, can be made to meet almost any specification laid out for the final product by the proper selection of sheeting and impregnating resin—the two elements that comprise this type construction If good thermal insulation is required, it is necessary to introduce an insulating material into the cells since the honeycomb by itself has a K factor little better than that of solid lumber If dielectric properties are desired, a glass cloth impregnated with a polyester resin is suitable To obtain fire resistance, an asbestos paper impregnated with a phenolic resin has been used

These honeycomb structures are made of a resin-impregnated sheet material which has been cured and assembled into the honeycomb design—either tubular or hexagonal While optimum cell size has not yet been determined, a core with 3/8 to 7/16 inch cells, measured across the flats, has proved satisfactory and economical in a general purpose application

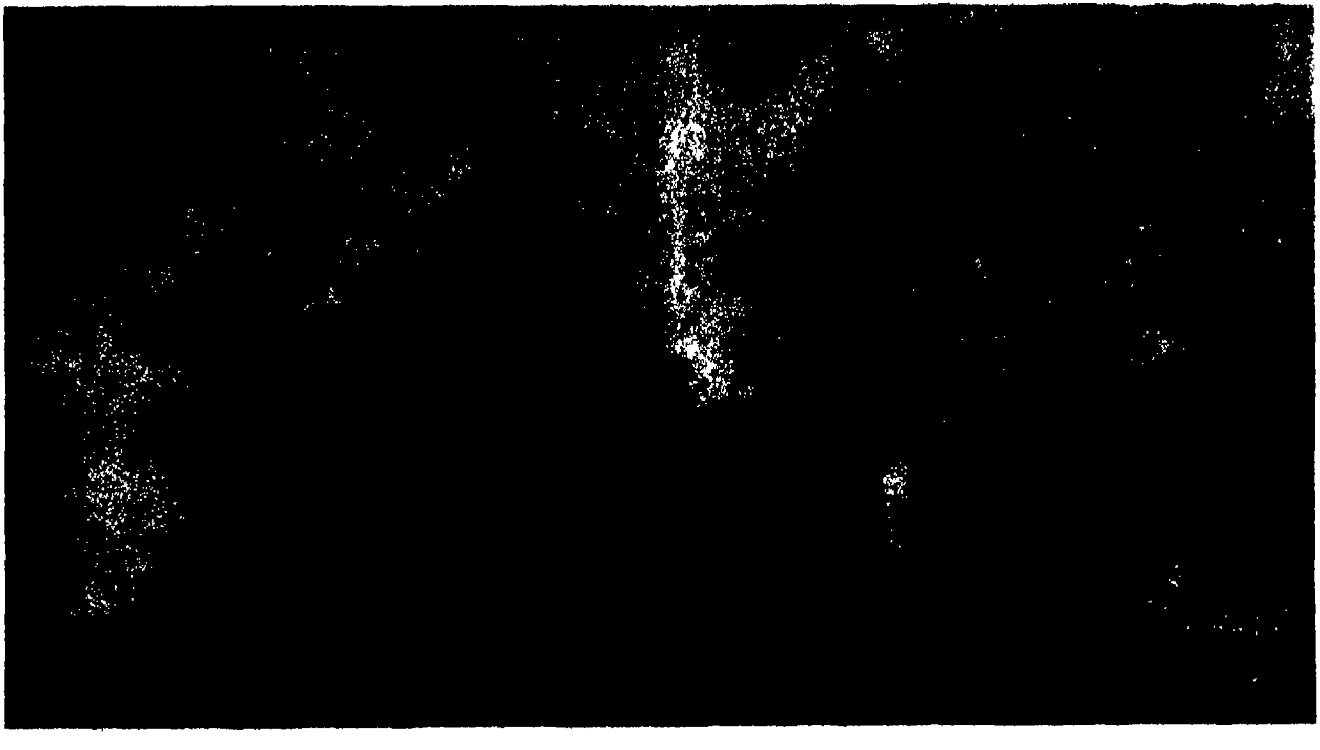
There are two methods of producing this type structure Honeycomb core can be cured on a corrugating drum in the form of a continuous corrugation These sheets are then cut to length, indexed, and assembled into block form, after which the block is sliced on a band saw into sheets for panels

The other method consists of strip-gluing single sheets of material to a pattern and stacking the sheets for curing in a press The cured blocks are then cut into strips which are expanded mechanically to make honeycomb core sheet This expanded honeycomb is sprayed or dipped in a resin bath, air dried, and cured in an oven to set the resin and stabilize the expanded structures

Laminates made with these cores are associated mainly with the transportation field Houses have been constructed, however, in which honeycomb laminates are used for walls and flooring Other suggested uses are air-freight shipping containers, cold-storage shipping containers, scaffolding, lightweight furniture, partitions, and trays for handling semi-finished work between processes

At least a start has been made in applying these versatile materials to the many civilian and industrial fields for which their properties would seem to suit them Price, however, is a factor that must be refined even further if the various expanded plastics are to be used in such articles as table tops (as a core material) or in the many types of packages for which they are fitted

Courtesy Lincoln Industries, Inc



Honeycomb laminates are employed in both walls and ceilings of this house

FUELS OF THE FUTURE:

For Ram-Jet Motors

By F. W. Schumacher
Associate Director, Process Division, Esso Laboratories

> ***Editor's Note*** **The accompanying article is the third of four, adapted by permission from papers presented at a recent Standard Oil Development Company seminar on Fuels of the Future Each paper deals with different phases of fuels for engines of types now in use, under development, or projected Together they summarize the general subject and furnish a glimpse of the fuels and engines which technology will be offering to transportation in the years to come**

JET PROPULSION depends upon the fundamental reaction principle a force is required to counterbalance a change in momentum, momentum being defined as the product of mass and velocity The rowing of a boat is an example Velocity is imparted to a mass of water by the oars Therefore, the momentum of the water is increased The counterbalancing force is against the oars, and it is this force which moves the boat

The original statement that jet propulsion depends on the reaction principle is correct, but a more specific definition is required if we are to avoid placing both the supersonic ram-jet and the row boat in the same classification

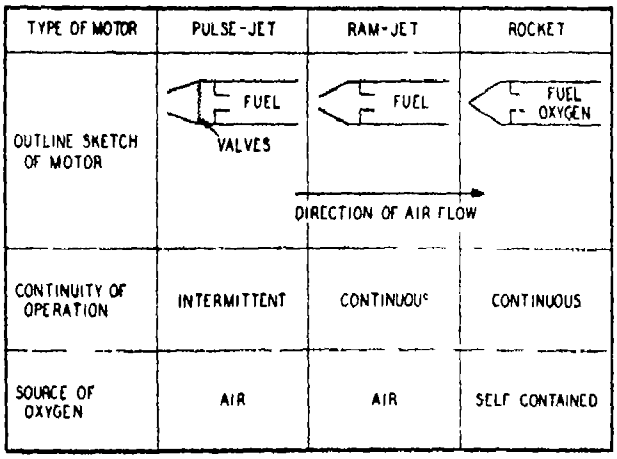
A more specific statement is that jet propulsion can or does take place when a change in momentum occurs by virtue of material being ejected from the propelled body If all the material expelled was originally carried by the propelled body, the device is a rocket If part was carried (fuel) and part taken in from the atmosphere (oxygen), it is some sort of jet engine—a turbo-jet, ram-jet, or pulse-jet

With jet propulsion so defined, the first reasonably authentic record of the application of the jet propulsion principle is the use of gun powder rockets by the Chinese several hundred years B C. The jet propulsion principle was employed by Hero of Alexandria in about 100 B C and many scientific historians consider him its discoverer He described a device known as the Aeolipile which, rather than a means of locomotion, was intended to be a stationary engine for production of power Steam exhausting through two tangential jets on cylinder caused the cylinder to rotate The steam rocket for jet propulsion of a vehicle was proposed many centuries later by Isaac Newton There were many other early uses of rockets, for example, the famous incendiary Congreve rockets with which the British burned most of the city of Copenhagen in 1807

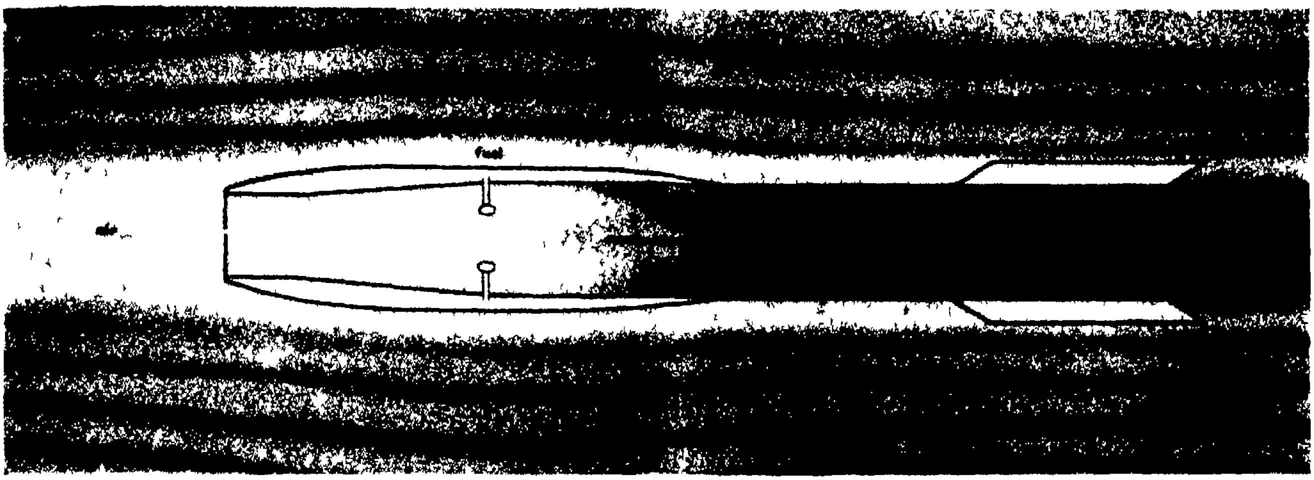
It was not, however, until early in the present century that the prototype of our modern jet motors was visualized In 1908, René Lorin proposed a propulsion system where the exhaust of an internal-combustion engine was used for jet propulsion The engine did not produce power in any other way Five years later, in 1913, he described a jet-engine where the air was compressed solely by the velocity, or ram, effect of the entering air This is the ram-jet

TUBE AND TAPERED NOSE-PIECE—The ram-jet has been described as consisting basically of a cylindrical duct containing flame stabilizing parts and a tapered nose-piece open at the end The inside of the ram-jet is therefore a duct of varying

Similarities and differences between reaction motors



TYPE OF MOTOR	PULSE-JET	RAM-JET	ROCKET
OUTLINE SKETCH OF MOTOR	FUEL VALVES	FUEL DIRECTION OF AIR FLOW	FUEL OXYGEN
CONTINUITY OF OPERATION	INTERMITTENT	CONTINUOUS	CONTINUOUS
SOURCE OF OXYGEN	AIR	AIR	SELF CONTAINED



Ram jets, "flying stovepipes," are the simplest of engines but are limited to "super" speeds. Flights at velocities of over 1400 miles per hour have been made

diameter into which air enters, and from which combustion gases leave. Air at supersonic velocities relative to the ram-jet approaches the circular hole in the leading end of the nose-piece of the duct. Supersonic flow of a gas inside a duct of this sort is thermodynamically unstable and tends to decrease sharply, the rate of flow becoming subsonic. This very sharp velocity decrease is known as a shock wave, and is accompanied by a rise in gas pressure and temperature. If the ram-jet burner pressure is at its design value, this shock wave is right at the leading edge of the nose-piece and maximum thrust will be obtained.

The conical section through which the air passes to reach the combustion section is known as a diffuser. In this section the entering air, now subsonic, is slowed down even more because of the enlarged cross section. The air pressure is also further increased as a result of the conversion of velocity energy into pressure energy. At the diffuser exit, the fuel is mixed with the air stream and combustion takes place, having been initiated by either a spark or pyrotechnic tracer. The flame is stabilized by parts inserted in the air duct for this specific purpose. During the combustion, velocity of the gases increases very rapidly through the duct and, just to the rear of the ram-jet, attains a speed up to 2000 miles per hour. When the velocity, and therefore momentum, increases, pressure must decrease, at the end of the combustion zone the pressure is little, if any, above atmospheric.

It now becomes evident how the ram-jet works. The momentum of the exhaust gases is greater than that of the entering air. This difference in momentum must be counter-balanced by a force, which is the pressure exerted on the inside of the diffuser wall. This pressure on the inside wall is greater than that on the outside, so a forward force, or thrust is exerted. Since ram-jets have been proved capable of flight, it is evident that this thrust is large enough to overcome the wind resistance, or drag, of the flying body.

For the past two years, the Standard Oil Development Company has been doing research on the development of ram-jet motors suitable for supersonic flight, at the request of the Navy. The Esso Laboratories are one of a number of industrial laboratories and universities co-operating in the development of a supersonic ram-jet, on a project known as "Bumblebee." This work is being done under contract with the Bureau of Ordnance of the Navy Department, and the Applied Physics Laboratory of Johns Hopkins University is providing the technical coordination and direction for the project.

POTENTIAL ANTI-AIRCRAFT WEAPON — The project was started during the war, when it was hoped that it would be possible to develop ram-jet propulsion so that it could be used in an anti-aircraft weapon against the suicide planes used by the Japanese. It now appears to have other applications, and the work has been continued with emphasis on developing the ram-jet as a means of supersonic propulsion. One of the major aspects of the work in these laboratories is the development of suitable fuels for these ram-jets.

An accompanying chart shows in tabular form the similarities and differences between the pulse-jet, the ram-jet and the rocket. Both the ram-jet and the rocket operate continuously, whereas the pulse-jet, as its name implies, involves intermittent combustion. Both pulse- and ram-jets obtain their oxygen by taking in air while in flight. The rocket, of course, carries its own oxygen supply with it. These characteristics are responsible for three fundamental differences.

1. The speed of pulse-jets is low by comparison with other jets, due to the intermittent character of the combustion. This type of propulsion was employed in the German V-1 missile.
2. The range of the ram-jets for a given weight is longer than that of a rocket, since oxygen is obtained from the air.
3. The altitude ceiling of the rocket is virtually unlimited since the oxygen supply is self-contained.

The ram-jet, shown in the accompanying over-simplified drawing, consists basically of a cylindrical duct having a tapered nose piece which is open at the end. The direction of flight as pictured is from right to left. Therefore, air enters the device in the opposite direction—from left to right. The entering air is compressed by reducing its velocity in the tapering section. Fuel is sprayed into the air stream and the resulting combustible mixture is ignited with either a spark or pyrotechnic tracer The combustion is carried out in the right-hand part of the system, and the flame is stabilized by several simple parts of special design The exhaust gases leave at a very high velocity, attaining a speed much greater than that of sound at the rear of the apparatus The force —the power—which makes a ram-jet go is the development of a pressure on the inside of the tapering nose which is greater than the corresponding pressure on the outside

NO MOVING PARTS—The construction of the ram-jet is very simple The motor proper contains no moving parts, which is quite a contrast to the reciprocating aircraft engine, and even to the turbo-jet For flight, the necessary wings and controls are added. Since the ram-jet cannot deliver any power unless it is moving, it cannot take off by itself Launching is accomplished by rockets Ram-jet units, usually about six inches in diameter and 12 feet long, have been nicknamed "flying stove pipes"

The internal design details of a ram-jet burner are inseparably related to the properties of the fuel employed To preserve the mechanical simplicity of the burner, a fuel must burn efficiently under the widely different temperature and pressure conditions encountered by a ram-jet in flight as speed and altitude are varied One of the objectives of the Esso Laboratories is to develop such fuels from petroleum

Supersonic flight has been proved possible with the ram-jet burners so far developed Short pilotless flights at velocities exceeding 1400 miles per hour have already been made When further developments make flights of moderate distances possible, this will be equivalent to a flying time of about 15 minutes from New York to Pittsburgh. A ram-jet will then be able to out-run the sun, and its pilot will be able to see the sun set in New York, rise over the horizon, and set again in Pittsburgh The flight will be made in the stratosphere where fuel consumption will be about a tenth of that required at sea level.

Present ram-jet burners are only a fraction of the weight of a reciprocating aviation engine of comparable power At 1400 miles per hour the ram-jet develops one horsepower for each one-half ounce of weight—more than 30 times the power developed per unit weight in a modern aviation engine One man can easily lift a 2000 horse-power ram-jet

Cabin cooling, which is of relatively minor importance in the transport planes now being developed, becomes a significant problem when sustained plane speeds of 1400 miles per hour are reached Without refrigeration, cabin temperatures of 300 degrees, Fahrenheit, will be approached by a plane traveling at 1400 miles per hour even in the stratosphere At 2000 miles per hour this temperature will become 650 degrees, Fahrenheit

What use is visualized for the supersonic ram-jet today? As stated, it is a fundamental method of high speed propulsion It was intended originally to propel an anti-aircraft weapon But it is evident that if supersonic transportation of mail, express, and ultimately passengers develops, the ram-jet motor offers great promise A military project thus promises to influence the peace-time transportation of the world

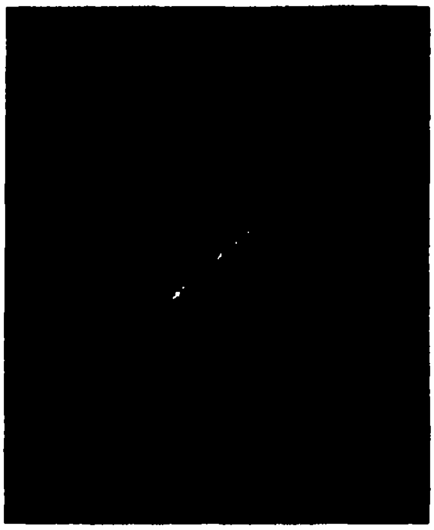
Test cell set-up for a ram-jet in which a fixed jet, equipped with measuring instruments, is supplied with 11 pounds of air a second at a speed of 1000 miles per hour

SCIENTIFIC AMERICAN'S *Industrial Digest*

NUCLEAR TRACK PLATES

Used to Record the Paths of Charged Particles

SPECIAL photographic plates made in the laboratories of Eastman Kodak Company are being used by scientists to picture actual atomic fission and to study action of highly charged nuclear particles



White streak marks the paths of two new atoms created by the fission of a uranium atom at midpoint of streak

The plates recognized as valuable new tools for research in nuclear physics, are known as "nuclear track" plates from their special use in recording the paths of the particles

Characteristics of the new plates are markedly different from those of ordinary photographic materials The plates are super-sensitive to the electrical charges carried by atomic particles At the same time they are relatively insensitive to light

The silver grains in the emulsions of the nuclear track plates are unusually close-packed It is these silver grains, suspended in the gelatine emulsion, that are particularly sensitive to the charged nuclear particles.

When a highly charged particle speeds into the emulsion, a dotted line of affected silver grains is produced These silver grains when the plate is developed, make an identifiable track This is the path of the nuclear particle through the emulsion

From the length and curvature of the track and the grain-spacing along it, information is obtained of the particle's speed energy and other characteristics Thus the particle can be identified as a proton alpha particle or heavily charged nucleus

Actual fission was recorded when one of the plates, first bathed in uranium nitrate was exposed to slow neutrons from a radium-beryllium source A neutron striking a uranium atom in the emulsion brought about the fission which was recorded on the plate as the track of two new atoms

CYLINDER CONTOUR GAGE

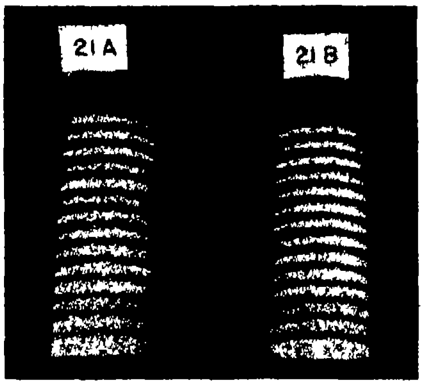
Measures Radial Distances to Give Accurate Picture of Wear

MEASURING the diameter of internal combustion engine cylinders at many points has long been used as a means of determining the amount of taper from the worn upper part to the unworn lower part and to determine the amount of out-of-roundness of the cylinder Such diameter measurements, however, do not necessarily give a true picture of the actual shape of the cylinder Badly misshapen cylinders often appear quite straight and round on the basis of the diameter measurements, because a low spot on a cylinder is quite likely to have a high spot directly opposite it, leaving diameter measurement relatively unchanged

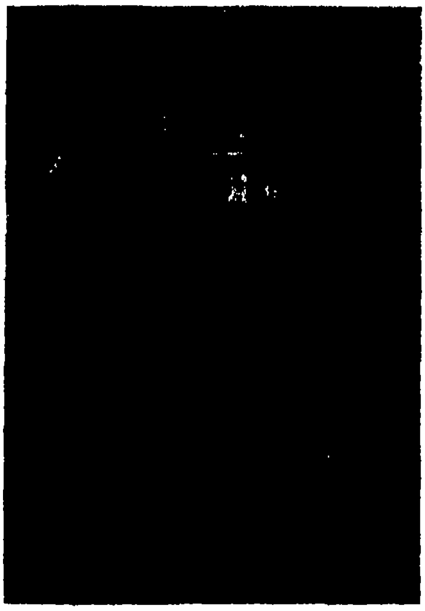
Only measurement of the radial distances from the cylinder axis to the cylinder wall can describe the true shape of the cylinder, a cylinder contour gage has been developed by the Perfect Circle Corporation for that purpose.

In operation, the contour gage is alined with its axis coinciding with the axis of the cylinder Radial measurements to the cylinder wall are made at as many points and at as many different levels in the cylinders as desirable Readings are usually taken at intervals of 5 to 20 degrees about the axis and in half inch steps down the cylinder The top inch of the cylinder is almost always measured in smaller steps because most of the wear takes place in that area

Scale models are made from the recorded data by plotting the measurements on stiff board connecting the points cutting out the contours and stacking the resulting disks with spacers of the same thickness as the



These exaggerated scale models, made from data obtained by contour gage, reveal the extent of cylinder wear



Contour gage in operation

level intervals of the readings In order that the contour may be easily visualized, deviations from the nominal cylinder diameter are magnified three hundred times when the constours are plotted

This gage was originally developed during the war for the study of distortion and wear in aircraft cylinders It is now being used extensively in the development of piston rings and the improvement of the conditions under which they must operate

GRAVITY-FEED DISPENSER

Saves Floor Space, Simplifies Packaged Goods Stocking

An interesting example of how simply gravity can be put to work is seen in a grocery dispensing device for super markets which has many advantages over conventional shelves and stacks This Food-O-Mat, as it is called, consists of tiers of metal racks gently inclined at carefully worked-out angles These racks are placed with their backs far enough from the wall of the store to permit stocking them from behind The packaged groceries are placed in rows on the racks, which slope toward the customer When a bottle, can, or box is taken by a customer from the front of the rack, the entire row slides down the inclined plane, with the next item taking its place at the front

The angle of incline must be carefully adjusted to insure that the packages slide down the rack when the first item is removed. And equal care must be taken to see that the goods do not slide so fast that they jump over the stop at the front of the rack and fall. Thus, the angle for racks containing heavy bottles or cans which roll easily is far less than that for those containing light packages wrapped in wax paper, for example

This dispenser, which was devised by the Grand Union Company, makes it possible to re-stock fast selling items as frequently as necessary without interfering with customers, it insures that goods are always at the customers' finger tips, rather than far back on a shelf, and it requires far less floor space than would shelves of equal area

A similar gravity-feed dispensing arrangement could be used in tool rooms, stock rooms, and so on, where its space saving ability, its neatness, and ease of operation would be of definite advantage

HYDRAULIC BULGING

Forms Metal Cylinders Larger Through Body Than Neck

One of the newer press-forming methods receiving increasing application is the bulging of metals in hydraulic presses An outstanding example of this type of work is in the making of stainless-steel dairy equipment by International Harvester Company

Segmental dies are employed for facility in loading and unloading the work When pressure is applied, the dies form a seal around the mouth of the drawn part After sealing, the hydraulic fluid is allowed to flow inside the piece and fills it out by forcing it against the dies, using pressures up to 3000 pounds per square inch Bulging produces a cylinder which is narrower at the mouth than through the body

Bulging is also employed to make aluminum alloy parts The high-strength alloys are formed more readily if heated to 400 degrees, Fahrenheit, and pressures up 4000 pounds per square inch are used —*F P P*

As soon as a package is removed from the rack, another slides down to take its place

IMPROVED CASTERS

Give Industrial Trucks New Abilities

While the airplane has had nearly everybody looking at the sky, a comparatively unnoticed but highly important improvement was going on at the floor level of industry Truck wheels and casters, those small but ubiquitous tools of materials handling, were being vastly improved

This "revolution in wheels," as punsters have called it, was not deliberately planned The war caught industry with an immediate need for handling more materials than ever before at higher speeds and over longer distances Complex materials-handling equipment was not available and could not be built in time The lowly truck, pushed by hand or towed by tractors, had to take over

The immediate result was the first real break-down service testing that these wheels and casters had ever had, and they stood up surprisingly well

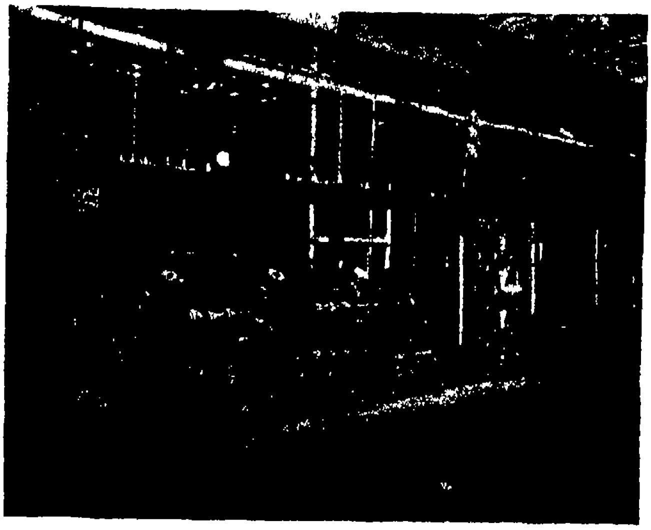
Later results were new designs, spring loaded axles, shock absorbing devices, better locking and fastening devices for fastening the wheels to the trucks, better floor locks for holding the wheels still while loading and unloading, and better tire and wheel materials —*E L C*

AUTOMATIC PLATING PLANT

Handles Copper, Chrome, Nickel In Continuous Operation

A fully automatic plating plant 660 feet long and 50 feet wide—three-quarters of an acre of continuous plating machines—was recently completed by the George L Nankervis Company, for one of the large manufacturers of automobiles The plating machines were built by Meaker Manufacturing Company

Four of the 22 motor generator sets which supply current for the plating operations—total capacity, 285,000 amperes



The plating solutions are filtered constantly and are heated with heat exchangers to maintain a predetermined temperature

Parts for automobile bumper assemblies coming out of the chrome plating bath

and consists of three sections—one for copper, one for nickel, and one for chrome

The first section, for copper plating, is 207 feet long and includes 15 automatic operations requiring 52 minutes to complete the cycle The main copper plating tank contains 58,000 gallons of copper plating solution, which is circulating constantly at the rate of 1500 gallons per minute, and is filtered at the rate of 1260 gallons per minute The circulating system passes through 16 heat exchangers to maintain a constant predetermined temperature By means of the pump equipment, the entire content of the copper plating tank can be transferred to an adjacent storage tank in 25 minutes

The nickel section, which is 250 feet long, includes 14 different tanks and operations, requiring 64 minutes for a complete cycle The nickel plating tank contains 67,200 gallons of solution which is the equivalent of 8½ tank cars The nickel plating solution is filtered constantly and heated with 15 heat exchangers Part of this nickel solution being circulated is passed through an electrolytic purification tank which is connected to a General Electric 2000 ampere, six volt rectifier

The chrome plating section is 139 feet long and includes ten automatic operations The main chrome tank, having a capacity of 15,700 gallons, is divided into two compartments, allowing two lanes of work which may be operated at different cathode current densities The chrome plating solution is circulated through both heat exchangers and coolers to maintain the predetermined temperature

There is a master panel at the starting end of each automatic machine If the machine is stopped for any reason, a light at the master panel indicates the point of trouble and the machine cannot be started again until the light is off, and a warning horn has sounded for at least 30 seconds In addition to this master panel, there is a stop cord available the entire length of the automatic machines

The plating capacity of these automatic plating machines it 22,500 square feet each, of copper, of nickel, and of chrome—a total area of 67,500 square feet of plated surface per eight-hour day The electrical energy for the plating procedures is supplied from 22 Chandeysson motor generator sets ranging in size from 5000 amperes at 6 volts to 15,000 amperes at 12 volts

Demineralizers with a capacity of 3000 gallons an hour furnish water for the plating tanks and the rinses preceding the plating The temperatures of the heated solutions and levels on all plating tanks, cleaner tanks, and power wash machines are automatically maintained All rinse sprays operate intermittently, as the work is being raised from the tank, by means of remote control switches, relays, and timers

Ventilation of tanks is afforded by 32 blowers with a total capacity of 434,000 cubic feet per minute

OIL FIELD ANALYSIS

By Following Tracer Through Sample Core With X-Ray

To help solve the riddle of how oil flows through the sand and rocks of an oil field, and how it is affected by underground water and gas, an X-ray method of studying a sample taken from a drill hole has been developed A small three inch by one inch sample, or core, from the drill hole is made to reproduce in miniature the layer of rock or sand from which it was taken Study of the reactions in the sample gives a picture of flow conditions in a stratum perhaps hundreds of feet thick and miles wide

The core is subjected to artificial pressures and saturations of oil, gas, and water, and the progress of these elements in the core is gaged by an X-ray unit called "apparatus for determining permeability-saturation" The X-ray beams follow the reaction by means of an opaque tracer mixed with the liquid or gas

An extensive series of flow experiments, reproducing conditions which might be created by various recovery methods, are run through The effects of gravity, capillary attraction and the amounts of oil, gas, and water already in the sand are charted By correlating such data, it can be determined how natural pressure, artificial gas injection, or water flooding will move oil toward well shafts through the various strata of the field being studied Methods of working the field can be planned accordingly to assure the greatest yield, and extent of yield can be forecast —*K.H*

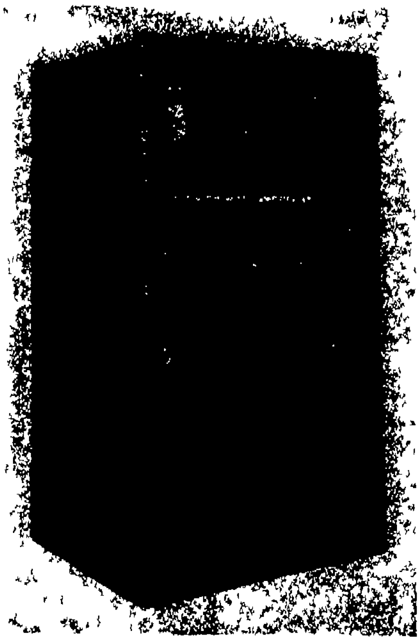
HOME DUST PRECIPITATOR

Eliminates Foreign Particles By Electrostatic Charge

Removing 90 percent or more of all airborne dirt when used in conjunction with a warm air furnace or an air conditioning unit, an electronic dust precipitator is designed for home use Far more effective than mechanical filters, it removes from the air not only the visible dirt, dust, and soot, but virtually all of the microscopic and sub-microscopic particles of smoke, pollen, and other contaminating particles down to as small in diameter as 1/250,000 inch

The precipitator, a product of the Raytheon Manufacturing Company is attached to the air intake of the furnace or to the intake of an air conditioning unit. No fan is needed as the air is circulated by the furnace or air conditioning system The precipitator consists of two principal parts the power pack and the heart of the unit—the ionizer-collector cell The power pack utilizes the regular house current to energize the ionizer, thus creating a strong electrostatic field

As the airbone particles pass through the electrostatic field, they become positively charged. Then the air passes down between the vertical collector plates. These plates exert a powerful electrostatic force which attracts the charged dust particles in somewhat the same way as a magnet attracts metal particles



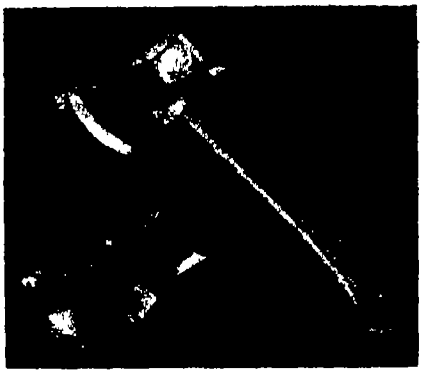
At top in the dust precipitator housing is the power supply, below which is seen the ionizer-collector cell

The collector plates are periodically washed to remove the dirt This is done by turning a valve which produces a spray of water over the plate When the unit is thoroughly dry, the ionizer is turned on again. The Raytheon Home Precipitator measures 54 inches high, 28 inches wide, 27 inches deep, and weighs 300 pounds Power consumption is only 50 watts

NEW VINYL USES

Include Fishing Tackle Cases, Axe Sheaths

New outlets are constantly opening for vinyl sheeting Among the latest of these are axe sheaths and fishing equipment cases which are fabricated of Vinylite by the Westcox Plastics Company An interesting feature of the axe sheaths, made from sheets 0 04 inch thick, for Fayette R Plumb, Inc, is the means used to achieve three dimensions A strip of rigid vinyl is welded to the inside of the sheath in a position corresponding to the wide section of the back of the axe The sheath is fabricated entirely on bar-type welding equipment —*C A B*



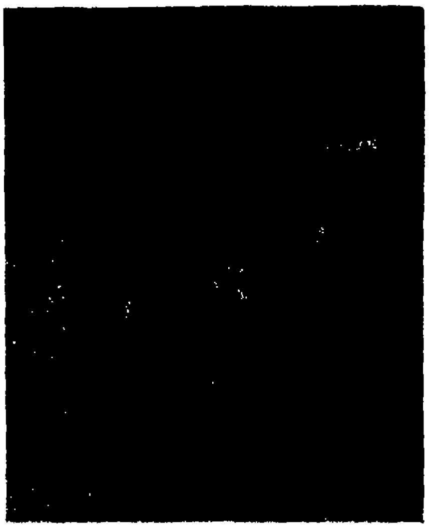
Sheaths are made from vinyl sheeting

HANDLING BY LIFT TRUCK

Results in More Efficient Storage, Speeds Many Operations

As part of the company's plans for a completely modernized handling system, the Pemco Corporation has recently put into operation a fleet of lift trucks. The newly adopted operations put emphasis on palletization of uniform "grid" stacking and vertical row removal of merchandise. Towmotor lift trucks in capacities of 4000 to 5000 pounds are used to transport the palletized loads of porcelain enamel frit, clays, chemicals, and other products

Since initiating this system of handling it is reported that lift truck operations, at no additional expense except for the cost of the trucks, have provided two thirds more usable storage space than was available with the former method of hand stacking, and that the amount of merchandise handled per man has increased approximately 60 percent



Providing two thirds more storage space

In addition to transport of the palletized loads, lift trucks are utilized for the difficult job of handling refractories kept in storage for repairs of their smelter units

Many operations have been reduced to one fourth of the time required under former methods, and it is expected that lift truck operations will greatly expedite shipments of materials

CYANIDE FROM GAS

Now a Possibility in Large Plants

A new process of recovery of hydrocyanic acid from coal gas is expected to put gas companies and by-product coke ovens into the business of producing this important fumigant for sale Heretofore the ordinary gas purification processes have turned hydrocyanic acid and hydrogen sulfide into the plants' furnaces to be burned to harmlessness Now both are to be recovered for sale in plants large enough to make the operation economical.—*D.H.K.*

New Products

VACUUM LEAK DETECTOR

Spots Minute Faults By Using Hydrogen as Tracer

DESIGNED for use in laboratories and factories to locate leaks that might eventually destroy the vacuum in such devices as electronic tubes, X-ray tubes, cyclotrons, vacuum stills, and furnaces, a new instrument utilizes a high-sensitivity gage tube which responds only to hydrogen. Hydrogen is used as the "ferret" in this leak detector, developed by the Radio Corporation of America, since it has the smallest molecule of any of the elements and therefore easily penetrates infinitesimal leaks.

Hydrogen finds leaks

In operation, the tube or other vacuum enclosure to be tested for leaks is hooked into the vacuum system of the leak locator, and a continuous vacuum is established between the instrument and the tube being tested. Hydrogen or other gas containing hydrogen is then applied to the outside surfaces of the tube under examination. If there are any leaks in the tube at points such as the glass-to-metal or metal-to-metal seals, the tiny atoms of hydrogen creep in, run down through the leak locator to the hydrogen-sensitive tube, which immediately registers the incoming hydrogen on the instrument's microammeter and thus indicates the presence of the leaks. Leaks once located can be corrected at the source in manufacture.

The new hydrogen-sensitive gage tube at the heart of the leak detector is an ionization type in which the bombardment of electrons sets up an ion current. The tube contains a palladium plate which, when heated, is porous only to hydrogen. Thus, hydrogen entering the instrument through a leak in a tube being tested, as described above, passes through the palladium plate, causing an increase in the ion current of the gage tube. The increased current is amplified and registers on the microammeter.

This new leak locator is simple in design, and extremely sensitive. It weighs only 25 pounds, is easily portable, and can be operated by non-technical personnel.

POCKET OHMMETER

For Preliminary Isolation Of Electrical Faults

COMPACT and inexpensive, a pocket-sized ohmmeter has been designed particularly for use by servicemen. Electrical faults in circuits and components can be quickly isolated with the instrument, making possible prompt estimates of service charges, time required for repairs, and so on. It is useful in checking radio and other electronic units, as well as many types of electrical equipment including automobile horns, relays, generators, and starters, electric clocks, and similar equipment.

In radio servicing, the miniature ohmmeter will indicate faults in difficult replacements including i-f transformers, tuning units, and audio sections, approximate values of individual resistors, and open or shorted conditions in other circuit components. It also provides a handy direct-reading means for spot check in automotive electrical equipment, industrial electronic apparatus, home appliances, and experimental or development electrical circuits.

From 0 to 10,000 ohms

The ohmmeter, made by Sylvania Electric Products, Inc., is enclosed in a tubular plastics case ⅞ inch in diameter and 5¾ inches long overall. Direct readings between 0 and 10,000 ohms are given on a 1.5 milliampere full scale sensitivity Weston meter in series with a 1000 ohm molded carbon resistor and a standard penlight dry cell. Test electrodes include a stainless steel prod built into the meter case and one secured to the tip of a 17 inch test cord.

ALUMINUM SOLDER

Needing No Flux, Shows High Strength in Laboratory Tests

INDEPENDENT laboratory tests on the metallic and electrical properties of a new aluminum solder from Switzerland proved that this material, which is used to solder aluminum to aluminum without a flux or flux substitute, resisted shearing after a 250 hour salt spray corrosion test, even though the aluminum base metal itself broke. Actual decreases in strength after the 250 hour salt spray test of the three grades of this Alsoco solder, designated as types M-1001, M-1002, and M-1003, were found to be 3 percent, 8.6 percent, and 4.6 percent, respectively. As for electrical resistance, the tests, conducted by the New York Testing Laboratories, revealed that when an aluminum wire was fastened to a standard copper lug with this solder, resistance of the joint was in the neighborhood of 20 microhms. After the 250 hour salt spray test, the average increase in resistance was only eight microhms.

The aluminum solder firmly joins the aluminum cable to this copper lug

Regarding the corrosion-resistant qualities of the solder, produced in this country by the Alsoco Corporation, metallographic examination of the soldered joints after the 250 hour salt spray test showed that there was no preferential attack on the base metal by the solder. Although the solder showed surface corrosion, it did not appear to be caused by galvanic action.

According to the laboratory report, the soldering operation, using the three grades of Alsoco, was fast and effective. No fluxes or any protective methods were used in the operation, and the flow points of all three grades were found to be well below that of aluminum and its commercial alloys

DUST CONTROL UNIT

Uses Capsuled Compound, Makes "Wet" Water Inexpensively

Concentrated and solidified, a cartridge three inches in diameter and eight inches long will, with a special proportioning unit, automatically proportion itself into a water line, providing up to 1000 gallons of "wet" water for dust control in mines, power stations, industrial plants, and similar places The automatic proportioning unit, which was developed specifically for the application of the compound cartridge, called Compound M, is a casting four and one half inches in diameter and 19 inches high It is connected directly into the water line, and the water pressure itself furnishes the power for both proportioning and spraying The unit is fully automatic, and is designed for over 100 pounds pressure It requires no adjustment or servicing, other than replacing the cartridge as required

The Compound M cartridge, produced by the Johnson-March Corporation, dissolves automatically in proportion to the water passing it, producing "wet" water so inexpensively and easily, without the necessity for pumps, motors, and mechanical proportioning units, that it can be available at any point for both dust laying and fire control

PLASTICS FUNNEL

Has Two Sections to Provide Three Different Sizes

A funnel which, in effect, provides not one but three sizes, is now available in the Kodak Combination Funnel Made in two plastics sections, the larger of which has an intake diameter of five inches and a spout two inches in diameter, and the smaller of which has an intake diameter slightly greater than two inches and a half-inch spout, the two halves fit together by friction and are ideal for work with large volumes of liquid that are to be poured into small-mouthed bottles

When, however, large volumes of liquid are to be poured into large-mouthed bottles, or small volumes of liquid are to be poured into small-mouthed bottles, the halves may be separated and used independently

Can be used together or independently

HYDRAULIC PUMPING UNIT

Actuates Rams on Automotive or Industrial Equipment

Operating in either vertical or horizontal position, a new low-cost hydraulic pumping unit is supplied with a six-volt driving motor, a reservoir-inclosed 1000 pound-per-square-inch hydraulic pump, a check valve, release valve, and an adjustable relief valve

The standard unit exerts a ram force of 2500 pounds at the rate of one inch per second with a maximum output of 46 cubic inches of hydraulic fluid Overall dimensions of the unit, manufactured by John Dusenbery Company, are 14 inches long by seven and one half inches in diameter, without mounting brackets

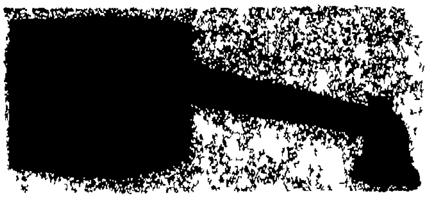
Exerts ram force of 2500 pounds

Primarily intended for actuating rams on automotive and tractor equipment, the standard unit may be modified for other uses. These modifications include larger capacity reservoirs, externally mounted four-way valve for double-acting cylinders, and a 115 volt A C motor for industrial applications

PHOTO-ELECTRIC COUNTER

With Light Source, Photo Tube, Counter in Single Housing

Designed to meet industrial needs for a compact, easily installed photo-electric counter, a new unit contains the light source, photo tube, and counter, all built into a single housing The counter operates on the interruption of light reflected from a swivel-type, adjustable reflector The relay will carry a load of up to three amperes continuously for eight million impulses. Minimum time for one cycle is 08 seconds, or 700 cycles per minute



Compact high speed counter

The sensitivity adjustment can be easily reached through an aperture in the housing, which permits settings for various light intensities The maximum number of counts before returning to zero is 99,999 The unit, a product of the Ripley Company, Inc, operates on 115 volts, 60 cycles current, and is applicable wherever a compact, high-speed counter is required

FUME RESISTANT ENAMEL

Protects Interior Surfaces from Acid, Alkali, Sulfide Vapors

Possessing unusually high resistance to acid, alkali, and sulfide fumes, a new white enamel can be applied to interior surfaces of wood, brick, concrete, plaster, or metal The surfacing is washable, and, if properly applied, it will not chip or flake This enamel, made by the A C Horn Company, is a polymerized thermoplastic elastomer, made from an olefinic base Called Fumex, it is supplied in brushing consistency However, it can be sprayed if first thinned with turpentine

RADIANT HEATING VALVE

Serves to Balance System as Well as to Vent Air

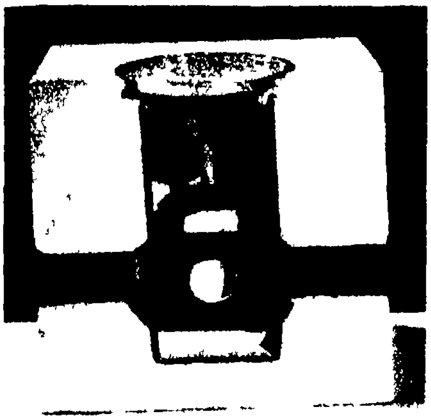
Expected to reduce materially installation cost of radiant heating systems, a combination balancing valve and air vent eliminates the additional piping, fittings, and welding which would otherwise be required for air vents

Basically, the purpose of balancing valves in radiant heating systems is to regulate water flow to individual coils in accordance with the comfort conditions required in the area serviced by those coils One valve generally is used for each coil Air vents are specified by most engineers to insure against air-lock even though radiant heating systems operate at relatively low temperatures

The "Radiantrol" Valve, as the new unit is called, is somewhat similar to a butterfly-type control valve It can be used with pipe coils buried as deep as eight inches below the concrete surface because the hollow brass control stem can be cut to appropriate size The stem extends from the valve to a brass floor plate 3⅝ inches in diameter, marked to indicate open or closed position This traffic plate fits flush with concrete floor and can be operated by foot A slightly different model is manufactured for hand operation These are designed to be located in a valve pit or off the floor in a cupboard or similar location.

The valve disk is built into a wrought iron body made of a short piece of pipe and end-beveled to facilitate welding into a section of the heating coil. Since the most popular sizes of wrought iron pipe used for radiant heating systems are 1 inch and 1¼ inch, according to records of thousands of installations, Homestead Valve Company is manufacturing Radiantrol valves in the 1¼ inch size, which is adaptable to both sizes of pipe.

The fiber container in which the valve is shipped is so designed that it may be used as the concrete pouring form, thus eliminating additional cost. Slots can be cut in the container to fit snugly over the pipe so that no concrete will flow around the valve itself.


Adaptable to 1 or to 1¼ inch pipe

GLUE SOFTENER

Assures Firm Bond With Gummed Tape

ELIMINATING the annoying and often costly loosening of moistened gummed tape after it has been apparently secured, a glue softening agent can be used with any tape requiring wetting before application. When mixed in a ratio of one part of softener to nine parts of water, the chemical assures a strong lasting bond by softening the glue more effectively than plain water. This material, called Tak by its manufacturer, Kano Laboratories, may be used with tape dispensers, label moisteners, envelope sealing machines, and so on.

SILVER BRAZING ALLOY

Features Strength, Fluidity, and Low Working Temperature

PENETRATING rapidly and completely between closely fitting parts, a new low-silver brazing alloy diffuses into the surfaces to be joined, producing an alloying action which forms a bond of great strength and ductility. The brazing alloy's unusually low working temperature (1145 degrees, Fahrenheit) makes it possible to raise the work rapidly to brazing temperature, resulting in a saving of time and heating energy.

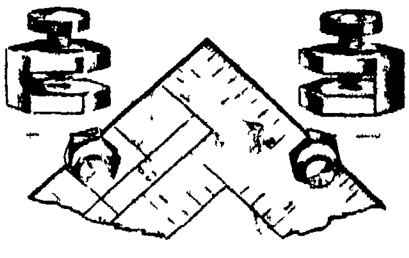
The alloy, called Easy-Flo 45, has unusual fluidity. The instant 1145 degrees is reached, capillary action draws the alloy, a product of Handy and Harman, quickly into the joint clearance, and spreads it completely throughout the joint area. Little or none is left outside. Thus, only a relatively small amount of the brazing alloy is required to make a strong ductile joint.

The fast brazing action, lower silver content, and smaller amount of alloy needed for a joint, in addition to the fact that through the use of the alloy, the number of rejects is said to be greatly reduced, all mean lower cost per joint.

STAIR GAGE FIXTURE

Once Set, Needs No Readjustment

SIMPLE, slotted, hexagonal fixtures designed to clamp on carpenters' steel squares to assist in laying out many types of angles are made of high grade nickel-plated steel and furnished with brass thumb screws. The fixtures may be clamped on instantly and secured with the thumb nuts. Set to mark out a given angle for a stair stringer, for example, this angle may be used accurately again and again without time-consuming placement of the steel square.


Courtesy A D McBurney
Fits on carpenters' steel square

MERCURY SWITCH

Is Fully Enclosed For Safety In Explosive Atmosphere

HERMETICALLY sealed by fusing metal to ceramic, small mercury switches are especially adapted to explosion-proof areas, the metal enclosure insures hazard-free operation in atmospheres where switch-sparking constitutes a danger. They provide mercury-to-mercury contact without arcing, pitting, or burning, and will operate at 110 and 220 volts A C or D C, in an ambient temperature of 100 degrees, Centigrade. Pressure of the gas inside the switch to quench the arc is 28 pounds per square inch above atmospheric pressure. Under test, it has been found that these small switches, product of Mercontrol, Inc, can stand an overload of 400 percent for a short period of time, they are provided with ratings of 5, 10, 15, and 20 amperes.

Only 1½ inches long by ½ inch in diameter, these switches may easily be installed in standard cartridge-fuse holders. Mercontrol switches are also available in a miniature unit, 1 inch long by ½ inch in diameter.

Ratings of 5, 10, 15, and 20 amperes

GAS PRODUCER

Creates Prepared Atmospheres By Partial Burning

GENERATING a prepared atmosphere by partially burning natural, artificial, or propane gas, a gas producer uses a micrometer-adjusting valve to control the air-gas ratio needed for the desired atmosphere. This definite gas-air mixture is then passed through a fire check valve and into the special burner, and is burned within the primary and secondary combustion chambers. The water vapor which results from combustion is condensed out of the prepared protective atmosphere by water cooled condensers and collected by means of water traps. The combustion chambers of this gas producer, manufactured by the Bellevue Industrial Furnace Company, are provided with a water jacket.

Specific protective gas atmospheres having higher hydrogen content with air-gas ratio of five to ten (air) to one (natural gas) may be provided by the use of the Bellevue special catalyst in the secondary combustion chamber.

This gas producer may be built in sizes to generate 350, 650, 2000, 3500, 9000, and up to 60,000 cubic feet per

Natural, artificial, or propane gas used

hour When lower than normal water content is desired in the protective gas atmosphere, the gas producer may be supplied with a refrigerating unit.

These producers find application in such processes as bright or clean annealing and sintering of ferrous and nonferrous mixtures in powder metallurgy

BETTER SEAT CUSHIONS

Are Filled With Resilient, Light Glass Fibers

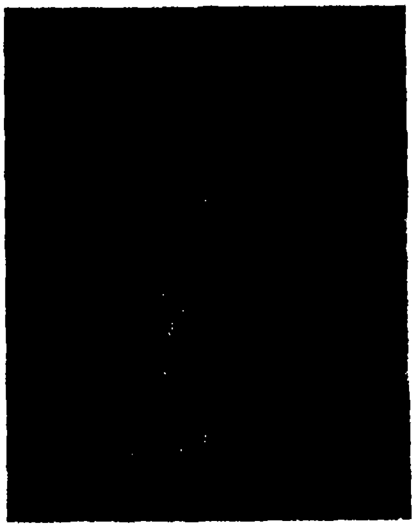
Providing a low-cost, light-weight, non-combustible, resilient filler for railroad, aircraft, motor coach, and automobile seat and seat-back cushions, superfine glass fibers show excellent over-all riding qualities In a typical aircraft installation, where weight-saving is of major importance, use of these fibers in seat and seat-back cushions has resulted in a weight-saving of two pounds per seat Identified as Fiberglas Superfine PF, Type A44, and produced by Owens-Corning Fiberglas Corporation, the individual fibers have an average diameter of 0 00011 inch In order to provide dimensional stability and handleability, the fibers are treated with a resin binder and formed into one inch thick blankets

Maximum riding qualities are obtained by folding, cutting, and installing the material in accordance with tested procedure It is recommended that batts be fan-folded vertically and compressed For handling purposes, the fan-folded pack can be held together by stitching through with coarse twine The pack is then sliced horizontally into pieces of the thickness required

VACUUM EXPOSURE HOLDER

Eliminates Fuzziness Due to Poor Contact In Radiomicrographs

Better X-ray pictures of microscopically thin sections of metal, paper, and textiles are possible with a new instrument that uses a vacuum to provide close contact between the section and the photographic plate



Developed for use in microradiography by Harold F Sherwood of Kodak Research Laboratories, the device is a "vacuum exposure holder" modeled after those used in the graphic arts

The holder consists of a rigid sheet of metal recessed enough to hold a glass photographic plate and the material to be X-rayed

When vacuum is applied through a tube leading to the recess, the section and plate are drawn together, and exposure is made with an X-ray tube

Previously, poor contact between a section and a photographic plate, or repeated exposures because of movement, usually resulted in a lack of sharpness This was noticeable in X-ray negatives magnified beyond 50 diameters

With the new instrument, fuzziness due to poor contact is eliminated Negatives are obtained that are reasonably sharp when magnified as much as 400 diameters

PORTABLE WELDING UNIT

Facilitates Joining of Aluminum In Hard-to-Reach Locations

Although built specifically for welding electrical conductors during construction and assembly work, a portable inert-gas metal arc welding unit is readily adaptable to many other applications This three-wheeled unit, constructed by the welding section engineers of the Aluminum Company of America, carries the welding transformer, cylinders of argon gas, and the connections for the water and drain lines for cooling the torch and power cables Electrical control provides protection for the torch against failure of the water supply, and also starts and stops the flow of both power and argon gas to the torch.

Welder includes gas tanks, transformer, torch cables, and cooling lines. Left: 75 feet of hose in cabinet permit a wide radius of operation

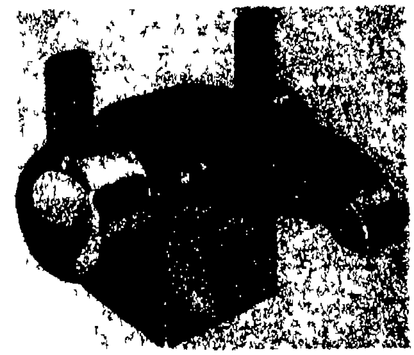
Torch leads, 25 feet long with a 50-foot extension, permit welding in positions usually considered inaccessible This portable unit satisfactorily joins aluminum tubing, extrusions, and sheet up to one-quarter inch The resulting joints are smooth and bright.

The unit requires a source of about 20 kilovolt-amperes of 440 or 220 volts at 60 cycles, and a source of clear, cool water at a rate of one-half gallon per minute with a pressure of 50 pounds

WATER FAUCET

Permits Temperature Control Independent of Volume

Intended for either domestic or industrial wash-room installation, a new type water faucet eliminates the annoyance of scalding the hands while one is trying to obtain water of the desired temperature Instead of the conventional system of having one faucet to control the hot water and another the cold, this faucet has one knob which regulates the temperature of the water and another which controls the volume After the volume-control knob of this Cole Valve Company faucet has been set to the amount desired, turning the other handle mixes the water to any temperature wanted without altering the volume Or the temperature knob can be preset before the water is turned on



Left-hand knob regulates the temperature; the right controls the volume

VELVET-LIKE FINISH

Achieved By Blowing Rayon Fibers Onto Adhesive-Coated Surface

Imparting a velvet-like finish on a variety of materials, a new finishing method is suitable for small shop application The necessary materials for producing the finish are supplied in kit form This kit contains an undercoat adhesive in two colors—brown and green—the Suede-Tex (as the material is called) in the same colors, an applicator brush, a bottle of thinner, and a spray gun for applying the Suede-Tex The adhesive undercoat is brushed on the portions of the object to be coated Then, before it dries, the same color of Suede-Tex is loaded into the reservoir of the spray gun, and the material is driven into the undercoat The material consists of extremely short fibers of rayon in a variety of colors The stream of air through the reservoir of the spray gun separates the fibers, causing each to drive straight into the undercoat at high velocity.

With one end embedded, the rest of the fiber stands erect, forming a pile somewhat like velvet.

Suede-Tex, manufactured by DonJer Products Company, finds wide application in coating the bottoms of such articles as ash trays, lamp shades, trays, candlesticks, and so on. It can also be used to cover books, albums, picture frames, toys, lamp shades and the like, and to line drawers, radio cabinets, and metal boxes It can be applied to any surface—metal, plastics, wood, paper, or cloth

IMPACT WRENCH

Removes Frozen Nuts By Momentum Of Spinning Weighted Handle

Badly rusted or jammed lug nuts on truck and tractor wheels now can be easily moved by an unusual type of wrench The usual twisting of an ordinary wrench is given great power in this new tool by putting to work the momentum of a free-swinging weighted handle The operator swings the weighted handle around the shaft, and as its lugs strike against the corresponding lugs on the shaft, its momentum is transferred to the shaft and lug nuts in a series of a hammer-like twisting blows that shock frozen nuts loose Both handle and shaft of the tool, called the Jari Shock Wrench, are of drop forged steel, heat treated and cadmium plated The handle is 24½ inches long, and weighs 10¼ pounds The shaft is 25½ inches long and weighs seven pounds The unit is designed to take all standard ¾ inch drive sockets and the shaft is also fitted with an integral socket

Takes standard ¾ inch drive sockets

The wrench, manufactured by Jari Products, Inc, can be taken apart or re-assembled in a few seconds and occupies but little space in a tool kit

CLEAR PLASTICS

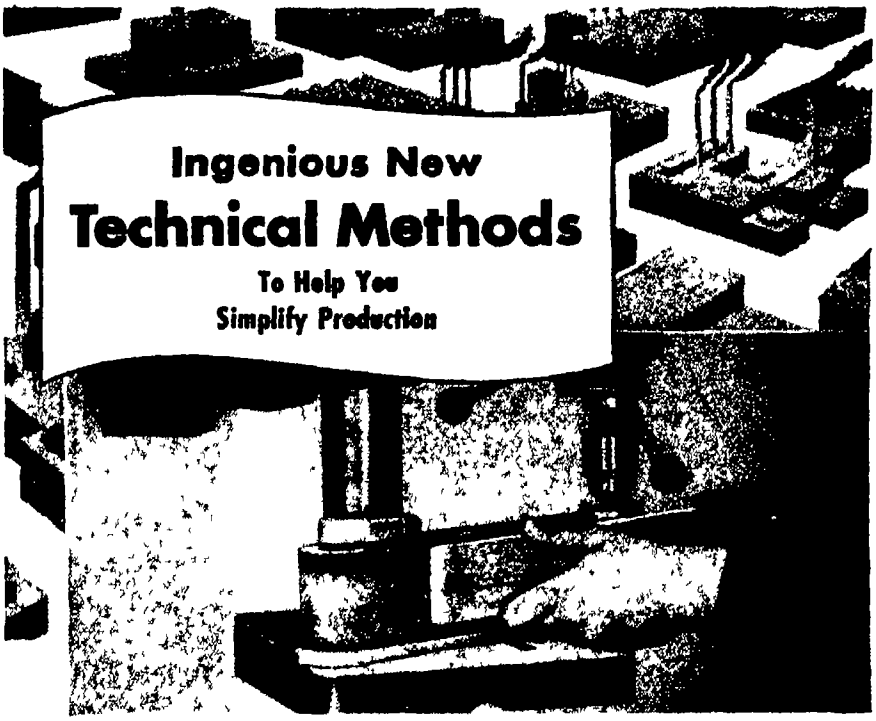
Hard and Flame Resistant, May Serve Best as Copolymer

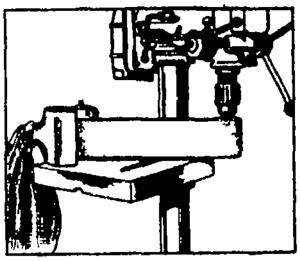
A colorless liquid in its monomeric (or original) form, diallyl phenyl phosphonate, a new plastics material, polymerizes (a one-way chain reaction) to become a transparent, thermosetting, hard, and strong resin which has been named V-Lite Flame resistance of pure diallyl phenyl phosphonate polymer, developed by the Victor Chemical Works, is such that it extinguishes itself within 30 seconds of removal of flame Index of refraction of the pure plastics is approximately 1.57, a figure higher than any but optical glass Not only does this fact cause improvement in appearance of common plastics when copolymerized with them, but it makes possible the production of clear sheets of plastics with an adjusted index of refraction

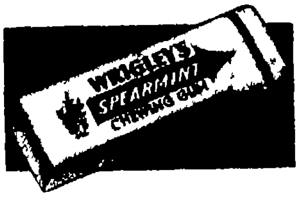
The Victor resin is insolube in ether, acetone, benzene, butyl acetate, naphtha, alcohol, carbon tetrachloride, water, 5 percent hydrochloric acid solution, or 5 percent caustic soda solution. It has proved stable when immersed in 30 percent sulfuric acid at 150 degrees, Fahrenheit, for more than five days

Speaking of possible uses for the new material, James M Gillet, director of industrial research of the Victor Chemical Works, said

"It is too early to predict in what manner our plastics will find widest application. The flame-resistance suggests coating use for flammable decorations or veneers, and as windows in passenger aircraft The high index of refraction suggests transparent laminates strong enough to support themselves in outdoor illuminated display work and for hail-proof greenhouse lights. The insolubility suggests use in chemical equipment and in storage







NEW BELT SANDER FOR DRILL PRESS

Does Finishing Jobs Faster, Better

A new, simple, faster method for many surface finishing jobs on wood, metal, plastic and other materials has been announced by the OK Specialty Company of Chicago The new finishing method takes the form of the OK Belt Sander, a drill press attachment

The new sanding device weighs less than 5 pounds It is made up of an aluminum base with backing plate or platen, a driven pulley mounted on ground steel shaft and running on precision ground ball bearings, and cast aluminum driver pulley mounted on ½" ground steel shaft to fit into the drill press chuck

The base of the sander is bolted to a drill press table Merely by moving the drill press table, the attachment can be adjusted to handle sanding belts from 26" to 36" in length

The sander takes belts from ½" to 3" in width Two sanding belts, one coarse grit and one fine grit, are furnished with each attachment The device comes assembled ready for use with any drill press Most efficient performance is achieved at 3500 to 5000 RPM The sander stands 5" high, and the base measures 10½" long by 3¼" wide

Another time-saver on the job is chewing gum Chewing gum may be used even when hands are busy; and under dust conditions helps to keep the throat moist—prevents "false thirst." For these reasons many plant owners make Wrigley's Spearmint Gum available to everyone

OK Belt Sander Assembled, Ready for Action

You can get complete information from OK Specialty Company, 4655 N Clark St, Chicago Ill

AB-69

CHANGING TIMES SHOULD BE SUCCESSFUL TIMES FOR EXECUTIVES!

Today, war worries have been succeeded by an atomic turmoil Far-reaching changes have always followed wars—and the man who has kept pace always comes out on top

Come what may, one need is never completely filled—the need for competent executives to direct business and industry In tumultuous times like those of today, this demand multiplies Right now, the outlook for ambitious men is brighter than ever before—if they have the training to take advantage of opportunities

The training needed is not narrowly specialized, but goes broad and deep, probing the basic principles that underly *all* business It provides the knowledge that enables men to direct the activities of others not in one department or one kind of business, but in *any* business It supplies the "know how" that enables top executives to manage *any* business

How to get such executive training

Training of this kind is provided by the Modern Business Course and Service of the Alexander Hamilton Institute The Course covers the four major functions of business—Production, Marketing, Finance and Accounting It turns out not accountants, or salesmen or production men, but *executives!*

Takes months instead of years

This knowledge takes years to acquire by ordinary methods Through Institute training, the process is concentrated and thus finished in a matter of months It does not interfere with a man's present position, being taken at home, during spare hours More than 430,000 men have subscribed, many call it "a turning point in their lives"

Many prominent contributors

One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors Among them are such men as Thomas J Watson, President, International Business Machines Corp, Frederick W Pickard, Vice President and Director, E I du Pont de Nemours & Co, Clifton Slusser, Vice President, Goodyear Tire & Rubber Co., and Herman Steinkraus, President, Bridgeport Brass Company

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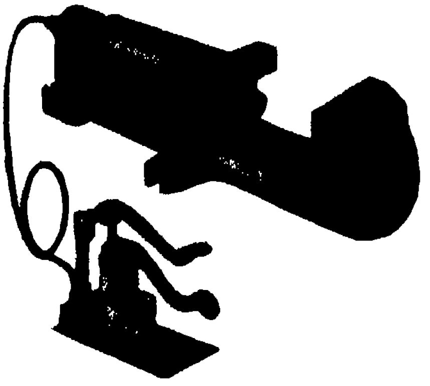
battery cases The hardness suggests copolymers for machined parts and for optical use We think the greater possibilities for the resin will be found as a complement to other plastics rather than as a pure material"

HYDRAULIC VISE

Of Sturdy Construction For Heavy-Duty Operation

Requiring no outside power source whatsoever, a new hydraulic vise is completely self-contained It has gibs of high-grade steel set at an angle of 45 degrees in V-ways of semi-steel, and is suitable for the heaviest vise operations Called Speedvise, this product of the Studebaker Machine Company is controlled by a foot pump leaving the operator's hands free It can be mounted in any position Two models are available, one with a maximum pressure of five tons between the precision-made jaws, the other with a grip of seven and one half tons

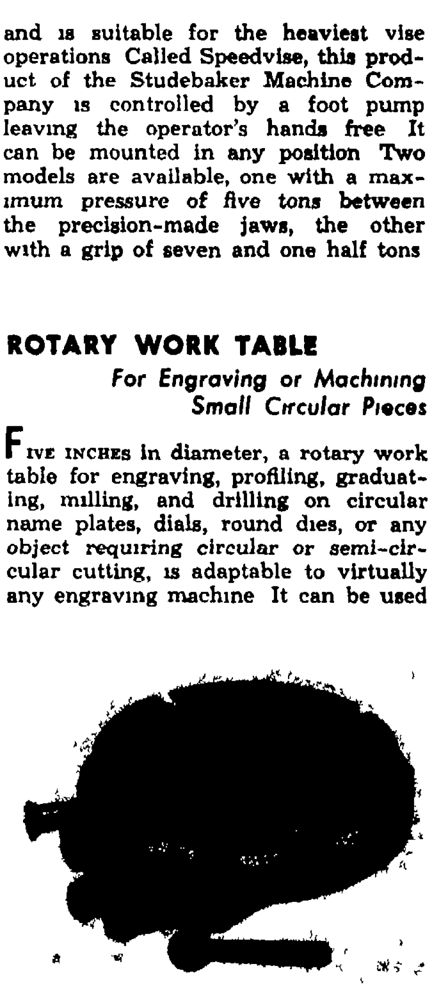


Foot pump leaves hands free

ROTARY WORK TABLE

For Engraving or Machining Small Circular Pieces

Five inches in diameter, a rotary work table for engraving, profiling, graduating, milling, and drilling on circular name plates, dials, round dies, or any object requiring circular or semi-circular cutting, is adaptable to virtually any engraving machine It can be used



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Cadet cart, box, black	$ 30 each
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to advantage also on small-production milling and drilling machines where, it is claimed, layout work can be greatly reduced on many types of jobs

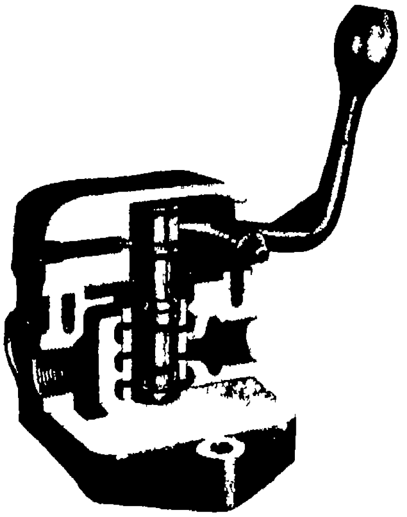
The outer rim of the turn-table, product of the H P Preis Engraving Machine Company, is marked in degrees and numbered at every tenth degree Every degree is notched for quick and accurate division by engaging the index unit This unit can be disengaged for free turning, using a cam-lock to secure the turn-table Top and bottom surfaces are ground accurately parallel to assure an even depth of engraving or other class of machining over the entire surface The working surface is provided with four tee-slots for ¼-inch bolts, and a ⅝-inch-diameter hole for centering the work with a stud The over-all height is only 1¾ inches, weight is nine pounds

AIR CONTROL VALVES

Have No Seats or Rod Packing, Are Easily Maintained

COMPLETELY re-designed, and now available in 79 standard models, a line of air control valves features sliding piston-type construction which eliminates valve seats and rod packing, together with the wear and maintenance they entail

These new air valves may be used in manufacturing and processing operations of all kinds, as well as for original installation in air-operated equipment on the market



One of 79 standard models

Effortless operation is assured, because these valves, manufactured by the Logansport Machine Company, Inc, do not operate against air pressure, the balanced construction produces equal pressure on both sides of the piston The pistons are light in weight, permitting high-speed operation and rapid reversals, particularly in the electrically operated models Longer sealing life is obtained through the self-cleaning construction, which wipes piston walls clean of abrasive particles with every piston movement

Quality—the controlling factor of all product performance—starts in your toolroom Here the jigs, fixtures, and tools that control the accuracy of production processes are made Consequently, your toolroom must be capable of precision work

PRICES of South Bend Lathes start at $145 00, f o b factory Average increase is *less than 15 per cent over prewar price level*

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Describes South Bend Precision Toolroom and Quick Change Gear Lathes with 9", 10", 13", 14½", and 16" swings. Also, Precision Turret Lathes with ½" and 1" collet capacities.

SOUTH BEND LATHES

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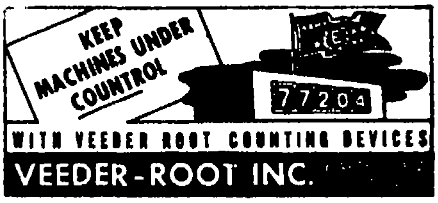
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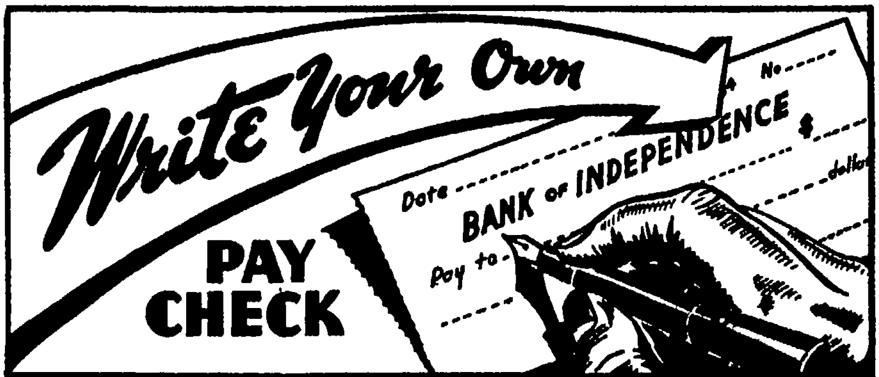
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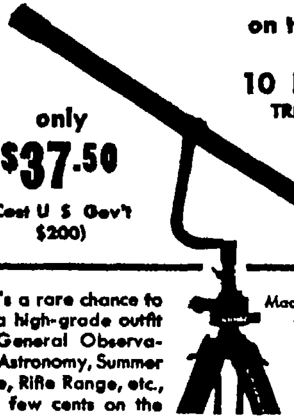

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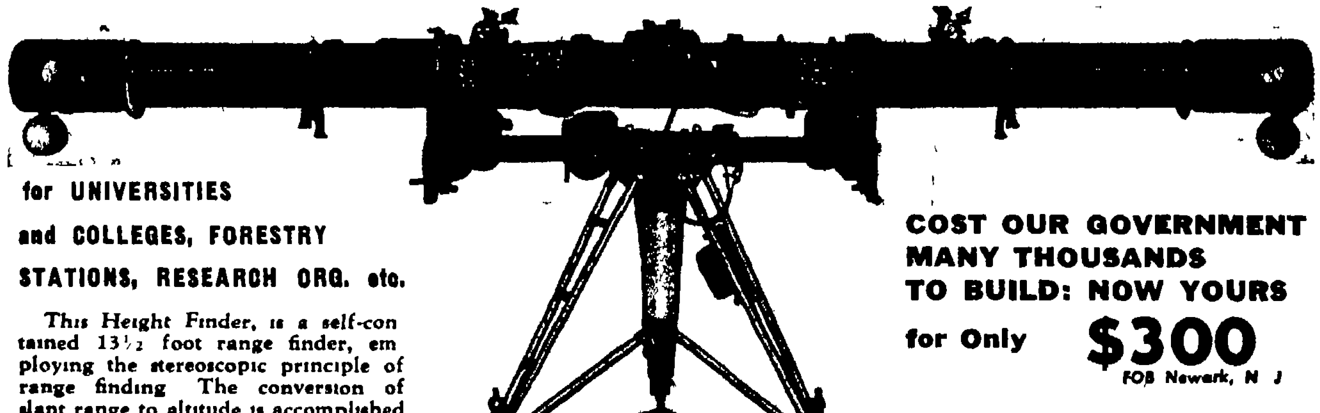

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" 'WOWS' MY NEIGHBORS"

Says Amateur Maker of Telescope

There is hardly a reader of Scientific American who has not at one time or another yearned for a man-sized astronomical telescope Some have been deterred by the cost of commercial instruments, others by the thought (erroneous) that telescope making requires some unattainable skill, some black magic beyond reach of ordinary mortals Excellent telescopes can be built partly from prepared kits of glass and grinding materials, with the aid of readily available instructions Almost any amateur mechanic can thus build a reflecting telescope for about one tenth the cost of a ready-made instrument of equal size and power And the thousands of amateurs who have made such telescopes attest that the work involved was actually fun—absorbingly interesting fun

An average beginner's first telescope

Typical of good amateur telescope design is the example shown in the illustration above, made by G M. Reavis, 933 Divisidero, Fresno, California In a letter to the editor, Mr Reavis writes "I have derived a lot of pleasure from it, especially when looking at the Moon, a view which always 'wows' my neighbors" This telescope is a half-portable instrument, a feature that will appeal to many

The functioning heart of a telescope such as Mr Reavis has made is a concave glass mirror disk ground by hand on top of an equal sized glass disk with loose grains of abrasive After a few hours the upper disk becomes concave, the lower convex but, having done its work, it is discarded and the other disk is polished with rouge and water against a layer of pitch. It is then coated with aluminum (formerly with silver) and installed in the lower end of the open-top telescope tube Near the upper end is a small flat mirror at diagonal angle which reflects the rays from the concave mirror into an eyepiece lens on the side.

Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

TERRESTRIAL telescopes for ordinary landscape gazing do not require the same top optical standards as astronomical telescopes and thus the one shown in the upper part of Figure 1, made by H. Clifford Allen, Princeton, N J, proved good enough for that purpose It contains an erecting system made of selected pieces of ordinary plate glass

Not certain his plan for a three-mirror erecting system was correct, Allen collected a few compact mirrors, feminine gender, arranged them as shown and proved that his idea would work Then he cut some pieces from 3/16" plate glass, tested them by interference against a standard flat, and selected three which were thus proved to be not more than two fringes (1/50,000") uneven These he front-surface aluminized and mounted as shown

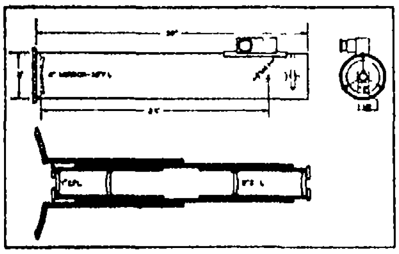

Figure 1: Two erecting systems

Using an eyepiece of 1¼" focal length he obtained a magnification of 26 diameters—the focal length of the main telescope mirror divided by that of the eyepiece—and he reports that definition, light-gathering power, and contrast proved very good in terrestrial observing

Plate glass diagonals, given some sanction in "A T.M," may satisfy the tyro when used with his first mirror, if selected as described there—as some have not been No matter how nearly flat they may be over their area as a whole, they still are not flat on a minute basis because plate glass is felt-polished and has a minute "lemon-peel" finish This diffuses some of the light. They get by easily on terrestrial telescopes (except target spotters) but less so for astronomical uses

A better erecting system is described by Doncaster G Humm, 1219 West Twelfth St, Los Angeles 15, California. He writes

"Reflectors make excellent terrestrial telescopes They are light and easily transported. Their light-gathering power is relatively high. The chief obstacle preventing their more frequent use in this field is difficulty in securing a good erecting system

"The Ramsden eyepiece used somewhat differently than is customary, offers a solution for the difficulty Bell notes in "The Telescope" that the Ramsden performs best when the faces are exactly their focal distance apart, but notes also that this brings every bit of dust into sharp focus, thus interfering with good vision This objectionable feature is not, however, noticeable when the Ramsden is used as an erector

"The Ramsden eyepiece consists of two plano-convex lenses arranged with their convex sides facing each other Usually, the two lenses are spaced two thirds or three fourths their focal distances apart

"The formula for the combination is $F = \frac{f_1 f_2}{f_1 + f_2 - d}$

"In this formula, F is the focus of the combination, f_1, the focus of one lens, f_2, the focus of the other, and d the spacing

"The best chromatic compensation is obtained with $d = \frac{f_1 + f_2}{2}$

"In the Ramsden suggested as an erector, $f_1 = f_2$ Hence, both equal d So, the formula becomes $F = f$ (1 or 2)

"Two such Ramsden eyepieces may be arranged in tandem (Figure 1, below) in such a way that the distance between them may be varied The closer they are placed, the lower the magnification, since the combination is in effect a low-power compound microscope

"I have such a combination mounted on a 6.5" reflector of 50" focal length Each Ramsden is mounted in a brass slip-tube 3" long One Ramsden has a

Figure 2: For quick height change

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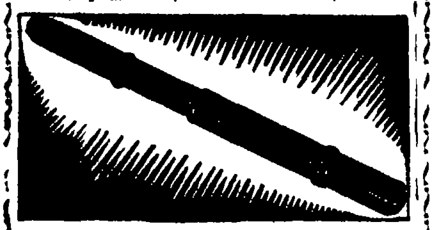

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"Astronomical viewing suffers little from the light loss caused by the erecting lenses, since seeing at from 50 to 75 power is more frequently possible than at high powers The reflector has been used to view the cloud bands on Jupiter, the globular cluster in Hercules, the great nebulae, and many other spectacles—all very effectively"

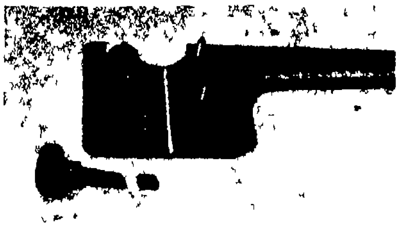

Figure 3: Arm with skate wheels

AMATEUR ASTRONOMERS who have had to run numbers of non-astronomical uninitiates quickly through observations well know how hard it is to manage the manipulations and keep the visitors happy For such uses the special mounting shown in Figure 2 made by John Holeman, 305 Thayer Drive, Richland, Wash, seems especially well adapted The telescope runs easily up and down its post on two roller-skate wheels which don't stick, and has a clamping screw It has a simple pointing handle which even your old Aunt Sally can work without a course in mechanics Holeman designed it for use in teaching large classes of totally unsophisticated observers who, of course, would be of all heights

The tripod at the bottom is made of ¾" pipe and the post is a piece of 1¾" seamless steel conduit The telescope is mounted on an arm which Figure 3 describes better than words The arm was built up of ¼" and ½" dural pinned together with taper pins and screws Holeman didn't have a casting

The alt-az mounting at the outer end of the arm is a Royal camera tripod head

"The RFT telescope," Holeman states, "contains a 3", f/6 Navy coated spyglass objective I made the mounting, including the toric cell ring and push-pull adjustments, from scrap The chart table shown in Figure 2 beside the observer (Mrs Holeman) is a folding photographic light stand (tripod) with a plywood table and spring clothespin clips to hold charts, as I also use this telescope for looking for telescopic meteors of which we see quite a few

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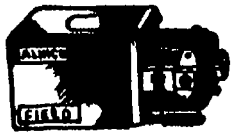

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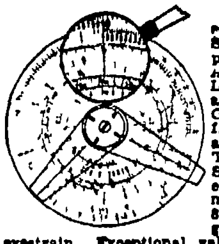

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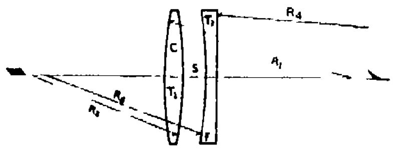
To pool among amateurs, through publication in this department, as many specifications for good objective lenses as can be found by its readers is an aim of its editor, expressed some time ago From Colonel Troy W Lewis, 1812 Schiller Avenue, Little Rock, Arkansas, come the specifications given in Figure 4 He writes

"This lens was computed and constructed with Parra-Mantois et cie crown and flint glass prior to the outbreak in Europe of World War II It gave excellent results on either nebulae or clusters, and was quite effective in terrestrial work when viewing objects against deep shade or in poor light.



Type 519604, *Hard Crown*, N_d 1 51899; V 60 4; C — F, 0 00859 Type 613369 *Dense Flint*, N_d 1 61323; V 36 9, C — F, 0 01661

(Radii that present convex faces to incident light are considered positive, concave faces against incident light are negative)

Finished diameter 2"; E f l 24"; focal ratio, 1:12 00

R_1 = +9 0213360"
T_1 = 0 2667840
R_2 = −7 7213592
Sep = 0 3333312
R_3 = −7 2730488
T_2 = 0 1666224
R_4 = +269 1965952

Gauss condition satisfied to	−0 0005671
Sine condition satisfied to	+0 0022351
Chromatic aberration on axis	+0 0001353
Spherical aberration on rim	0 0000000
Chromatic Dif of Mag on axis	−0 0032680

Figure 4: Lens specifications

Because of its large light-gathering power and short focal length it should make an exceptionably desirable objective for a spotting telescope or, with some modifications, a night-glass for rich-field observation

"When French glass became unobtainable the design was recomputed for Bausch and Lomb optical glass with the thought of making the objective available for amateur construction That computation, although performed with patience, was made during odd moments using log-tables and pencil under trying conditions The probability of error in the calculations became at once a sobering factor making it seem imprudent to release the specifications without further study Since the time necessarily involved to re-check the work could not then be taken from missions of greater importance it was thought advisable to withdraw the design from the publisher

"Recently it was my good fortune to acquire a large computing machine that is capable of the highest class of work Now that it appears probable English optical glass soon will be on the American market again, and since Chance Brothers Company, Smethwick, England, makes a glass-pair highly suited

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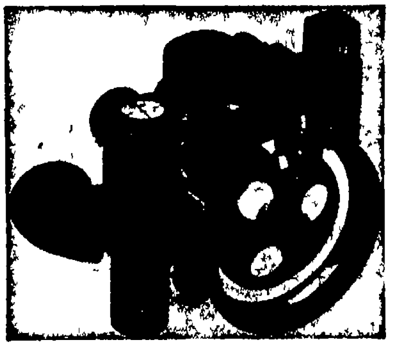

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to this air-spaced design, I have recomputed my Clark-type objective to be made with Chance Brothers' glass specified in Figure 4. The glass is obtainable through the American Agents, The Ednal Company, Inc, 95 Madison Avenue, New York.

"This objective design was subjected to a careful trigonometrical trace of two rays through both the axial and rim regions Spherical and chromatic aberrations have been reduced to zero, or practically so I was unable to satisfy fully both sine and Gauss conditions simultaneously, due in all probability to the form of the objective rather than to the glass selected, but the residuals, as shown in the specifications, are considerably smaller than the amount that can be tolerated in this type of lens when used for the purposes indicated A slight increase in separation would satisfy entirely the Gauss condition but other more desirable corrections would be slightly upset The chromatic difference of magnification on the axis, now roughly −0 0033", would be slightly enlarged, while the error against the sine condition, now + 0 0023", would be increased. The corrections as they stand are probably of astronomical grade although not so claimed The highest class of terrestrial objective is claimed

"I have not actually constructed this particular Clark-type objective with these specified English glasses, although a similar objective has been made with French glass to specifications not so perfect as those given here Splendid results were achieved, as previously stated, and no reason is seen why this recomputation for English glass should not prove equally good Judging from past experience, and relying on the accuracy of the computing machine, I am convinced this objective will fully satisfy those amateurs who may choose to make for themselves a fine spotting telescope from those specifications

"After long and careful study of this design I am forced to conclude that the perfection attained in the original Clark air-spaced objectives was due more to the magic touch of Lundin, the elder, than to the exact science of pure mathematics My air-spaced objective, when made to specifications, will prove to be highly acceptable If we have the necessary skills we may hope to satisfy both the sine and Gauss conditions by figuring the fourth surface slightly. Perhaps, with diligence and patience, we, too, may attain the high degree of perfection seen in the masterly work of Lundin"

Doctor D Everett Taylor, Willimantic, Connecticut, has made the valued suggestion that the telescope be equipped with a roof prism inverter for terrestrial use, also that the surfaces be given a coating of fluoride, which should add much to resolving power

Any reader who undertakes this objective is invited to keep in touch with Colonel Lewis or with this department, or both—though progress reports to either one are likely to be seen by the other since this department similarly keeps in direct-mail touch with numerous readers everywhere

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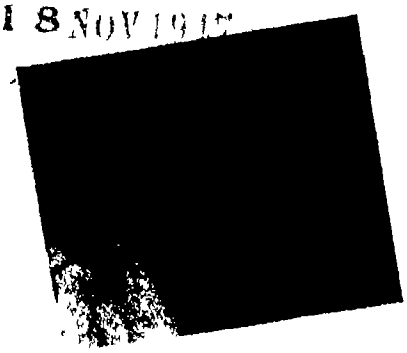

INDUSTRIAL DRAMA: Ball bearings so small that their lubricant is applied through a hypodermic needle are only one group in the "18,000 ways to fight friction" See page 149

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50 Years Ago in . . .

(Condensed from Issues of October, 1897)

STILL IS — "It is characteristic of the times that there should be a growing disposition, just now, to inquire into the working of the patent laws of the country The progressive spirit which prompts the inquiry is, on general principles, commendable At the same time it should be borne in mind that the question of a change in existing laws should always be approached in a guarded and conservative spirit, especially when it affects a branch of our laws like that relating to patents, under which such splendid results have been achieved"

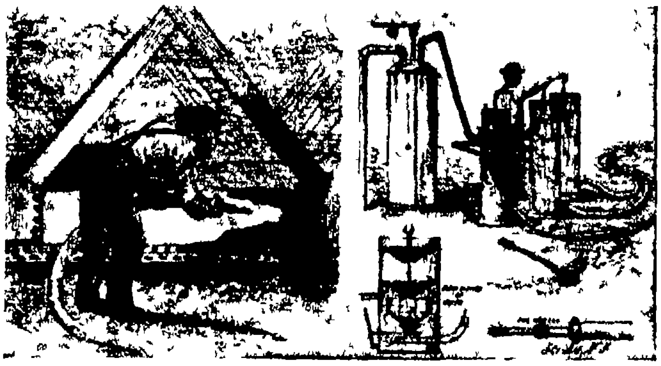
LIGHTING PLANT — "The Westinghouse Electric and Manufacturing Company has received from its European company notice of the award to it by the Metropolitan Electrical Supply Company of the contract for a large electric lighting plant to be installed in London The apparatus will be of the multiphase type, involving the use of the Tesla patents"

PAVING — "Since the asphalt street has come to be generally acknowledged superior, in essentials, to all others, the adoption of asphalt for paving purposes has become the rule in all of the more important cities of the United States"

HATTERAS LIGHT — "The Lighthouse Board has sent out a notice that the dangerous Diamond Shoal off Cape Hatteras will soon be marked by a first class vessel bearing two powerful electric masthead lights and a fog siren that will blow a blast audible twelve miles in the heaviest weather"

PNEUMATIC TUBES — 'Shortly after noon on the 7th instant the first section of the pneumatic postal tube service, which is now being installed in this city, was opened for regular service There are two tubes, each 8⅛ inches in diameter, the bends being made of brass and the straight sections of cast iron The interior surface is smoothly finished off to assist the passage of the carriers The air-compressing plant is located at the General Post Office, and a pressure of 6 pounds to the square inch is employed for the present, though pressure and speed may be increased if desired"

SAND BLASTING — ' The massive steel viaduct which carries 155th Street across the terminal station of the Manhattan Elevated Railway has suffered very serious corrosion, as the result of the gases which are continually playing upon it from the locomotives of the road It has been decided to first thoroughly clean the steelwork by the sand blast and then paint it with eighteen different varieties of paint As times goes on, a careful record will be made of the behavior of each variety of paint It was necessary to get rid, not merely of the old paint, but also of rust and scale, and the consulting engineer of the board decided this result could only be secured by the use of the sand blast. The air is compressed by two Ingersoll-Sergeant machines, which deliver to a receiver which has a capacity of 30 cubic feet The nozzle is 8 inches in length with a 9/16 inch opening, and is made of chilled iron, with a view to resisting the abrasion of the sand The speed of the mixture of sand and air is about 300 feet per second"



Sand blasting and equipment

GOLD VERSUS COTTON — "While the few lucky miners who have reached the Klondike are digging for the gold in the frozen ground of their Arctic homes, and stories of the wonderful richness of the mines are published to agitate a world of readers, a different kind of a gold mine is being worked in another fairer and warmer part of our country, where the sun shines eternally and the conditions of life are all that one could desire for comfort and pleasure The great cotton crop of the Southern States is worth several Klondikes, it yields profits to hundreds of thousands of toilers, and enriches our country by many millions of dollars Our exports of cotton alone amount to more than the output of all the gold mines of the world'

EXPLOSIVES — "The ingenuity that has been exhibited of late years in the discovery and application of explosives for mining purposes has really been remarkable Not only has the number of factories more than doubled in 20 years, but the number of persons employed in them is now over 10 000, which shows an increase of nearly 3,000 even during the last ten years"

CABLE — "At its last session the Icelandic Parliament decided to accept the offer of the Great Northern Telegraph Company in Copenhagen to lay a submarine cable to Iceland from the north of Scotland via the Faroe Islands"

100 Years Ago in . . .

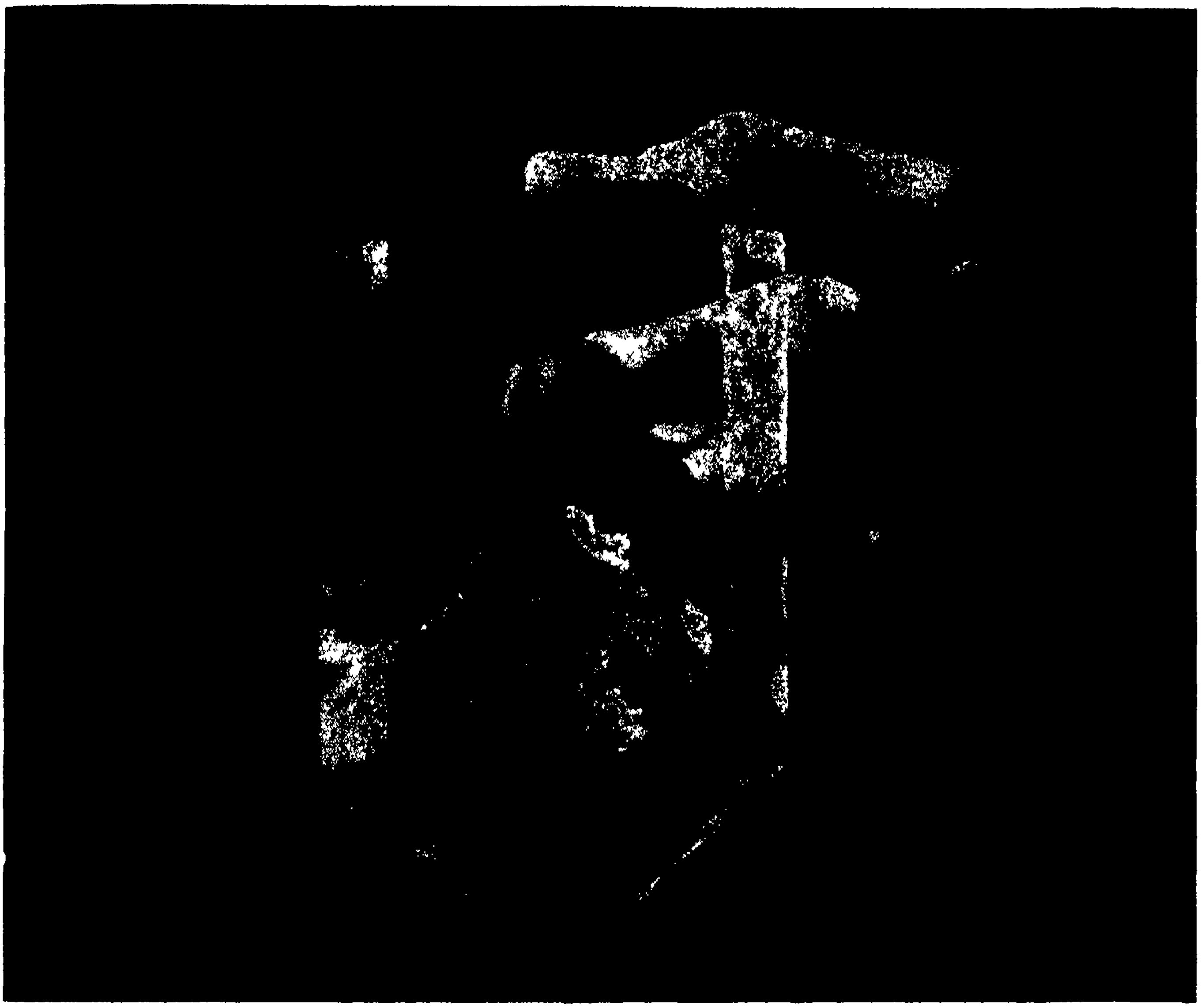
(Condensed from Issues of October, 1847)

TELEGRAPH NEWS — "The Louisville Journal is informed that House's printing apparatus is to be attached to the battery of the electric telegraph in that city By this arrangement, the managers expect that they will be able to furnish copies of the President's message for the newspaper offices in that city within five minutes after the reading of it by the clerk of the House of Representatives'"

LABOR COMPETITION — "The employing and employed mechanics are making active war upon the employment of convicts, in the county penitentiary, in shoe making, and other business, at rates which defeat the fair competition of trade, and to take legal means to prevent it"

WATER PIPE — "The extent of water pipes now laid in the city of Boston is about sixteen miles, of which nearly a mile is pipe of 30 inches in diameter and more than half a mile including the main pipe laid in Washington street is of 24 inches The greater part of the residue is of 12 and 6 inches"

RAILROAD IRON — "There will be sixty thousand tons of railroad iron manufactured in this country during the present year, which will be equal in quality to any imported iron The value of this quantity, at present selling prices, will be upward of four millions of dollars"



A CRYSTAL THAT GREW FROM A SEED *The large crystal in the foreground is an EDT (Ethylene Diamine Tartrate) crystal It started from a seed (a piece of mother crystal) and in three months grew in a slowly cooling solution to the size shown The small plate is cut from a large crystal, then gold plated for electrical connection and mounted in vacuum Cultivated EDT crystals can do the same job as quartz in separating the nearly 500 conversations carried by a coaxial circuit*

Crystals for Conversations

At war's end, the Bell System began to build many more Long Distance coaxial circuits Hundreds of telephone calls can be carried by each of these because of electric wave filters, which guide each conversation along its assigned frequency channel Key to these filters was their frequency-sensitive plates of quartz

But there was not enough suitable quartz available to build all the filters needed Bell Telephone Laboratories scientists met the emergency with cultivated crystals Years of research enabled them to write the prescription at once—a crystal which is grown in a laboratory, and which replaces quartz in these channel filters

Now Western Electric, manufacturing unit of the Bell System, is growing crystals by the thousands Many more Long Distance telephone circuits, in urgent demand, can be built, because the scientists of Bell Telephone Laboratories had studied the physics and chemistry of artificial crystals

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Previews of the Industrial Horizon

By A. P. Peck

MORE ON NUCLEONICS

Recent ground-breaking for new buildings at the Brookhaven National Laboratory (Long Island, New York), marked the beginning of construction of the first peace-time atomic pile Here work will be pressed on fundamental research in engineering, chemistry, physics, biology, and medicine This newest pile, while not the largest, will be extremely flexible and well adapted to the experimental and research work for which it was designed

Scientists at the ground-breaking ceremonies spoke at some length on "tracer" uses of the radio-active isotopes which they plan to produce Most widely publicized of such uses thus far are in the study of human-body processes, where radio-active isotopes are introduced into the system, and in the investigation of the arrangement of atoms in metals by adding tracers to the ingredients of an alloy while it is being made Just as fascinating—and perhaps even broader in scope—are the possibilities of adding tracers to fertilizers and thus gaining invaluable information on the effect of various fertilizer ingredients on plant growth, tremendously increased productivity of cultivated areas are a prospect Closely allied are the projected uses of tracers in determining the diets which will produce the most beef and pork from cows and pigs in the shortest space of time

On other aspects of nucleonics, Dr Arthur H Compton, Chancellor of Washington University and noted physicist, has this to say about the enormous importance of electrical power production through utilization of nuclear energy "It will make possible the spreading of industry into regions far from any supply of fuel New territories will be opened New areas will be made available for growing population How soon will this come? My own estimate is that it will be hardly ten years before those responsible for establishing new power installations will, in some cases, consider uranium as a serious competitor with coal. It may be a generation hence before the total uranium power production will compare in magnitude with that from coal"

SOLID FLUIDS

Fluid-catalytic cracking of petroleum has become of vital importance to the production of gasoline Essentially the process depends upon the use of catalysts reduced to such a state of fineness that, suspended in a stream of gas flowing upward, the solid catalysts behave like fluids and can be controlled in the same manner as if they actually were fluids The flexibility of the fluid-catalyst process gives excellent temperature control and intimate contact between the catalyst and the material being processed An added advantage is the ease with which the catalyst can be revived.

Now the fluid-powder technique is being expanded It is being applied to the burning of limestone to make lime, to the manufacture of fuel gas from coal, to the production of coke from powdered coal, and to similar operations The characteristics of the process are such, and its advantages are so great, that it is certain to find broad applications throughout the chemical industry

GLUE REPLACES RIVETS

Indicative of the almost unbelievable advances in adhesives is the recent announcement by The B. F Goodrich Company that a cement has been perfected which can be used instead of brass rivets to fasten lining to automobile brake shoes. Further, it is claimed that this new cement (the formula is still secret) has more than twice the shear-resistance of conventional rivets Still further, it permits use of the lining right down to the shoe instead of only to the tops of the rivets, which practically doubles the service life of the lining.

When an adhesive can do a job like this, it really opens cement horizons unlimited!

LIGHT-WEIGHT WOOL

Australia, land of the kangaroo (for mammilian curosia) and of the sheep (for crass export commercialism), is experimenting with spider-web-light woolen fabrics as possible commercial competitors with silk, rayon, and nylon These feather-weight cloths are reported as being woven from woolen thread so thin that it cannot be handled alone, it must be combined with a material that gives enough strength to withstand the weaving process and which can later be dissolved, leaving a wool structure claimed to be softer, warmer, and more sanitary than silk Those who have a leaning toward fine wool in clothing will see here a brilliant spot on the textile industry horizon

STRAWS IN THE WIND

That more efficient tools can lead the way to a sounder national economy, through a high level of productivity, will be amply demonstrated at the Boston convention of the American Society of Tool Engineers to be held late in October. . Commercial possibilities of obtaining oil from shale are being proved in a Colorado pilot plant. Electrical utilities will spend a billion dollars a year for the next five years for plant additions. High-grade castor oil for industrial uses is being produced from Oklahoma castor beans.

18 NOV 1947

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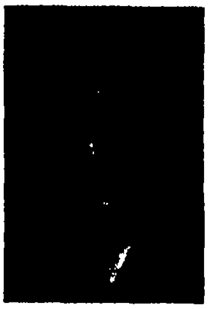
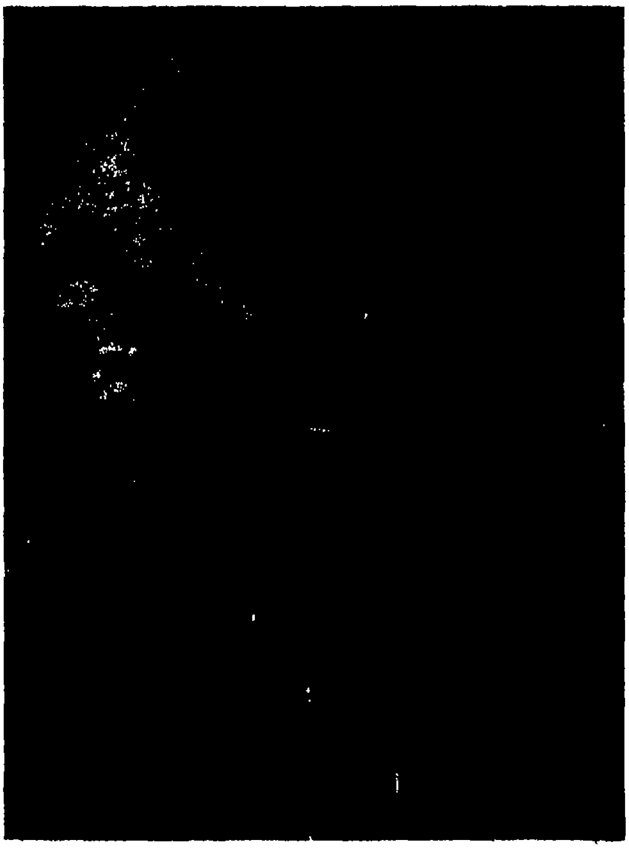
18,000 Ways to FIGHT FRICTION

By H. O. Smith
Secretary of the Anti Friction Bearing Manufacturers Association



Reducing to a Minimum the Friction With Which Our Entire Civilization Moves, Ball and Roller Bearings of All Types and Sizes are Major Contributing Factors to the Super Speeds Which Characterize This Age. Continuing Research is Yielding Better Materials and Better Lubrication



Assembling parts which make up a tapered roller bearing

Approximately 250 million ball and roller bearings were produced in the United States last year to carry on a war that never ends.

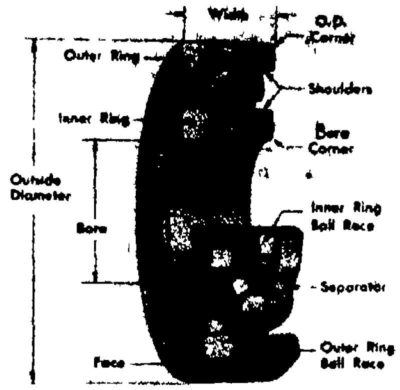
This is the war against friction, the deadly enemy of all movement, and it has been in full swing ever since that day when some forgotten man of antiquity first hacked out a crude wheel and attached it to an axle.

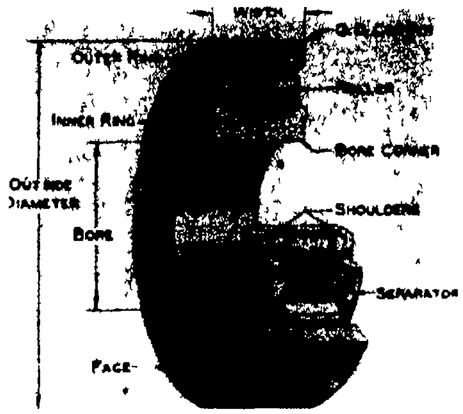
Some idea of the importance of the modern antifriction bearing can be gained from this fact. If all the ball and roller bearings were suddenly removed from every kind of machinery, life in big cities would be reduced to the level of a medieval fortress town. Famine, plague, and complete isolation would result because virtually all forms of power transmission, communication, sanitation, and transportation would cease. Throughout the world, modern civilization itself would come to a grinding halt.

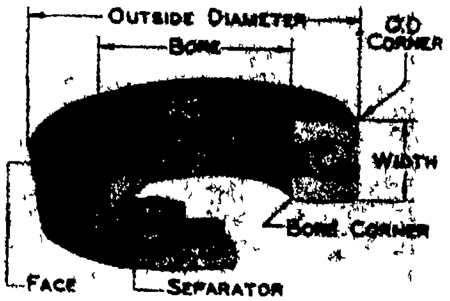
The science of fighting friction can be reduced to a simple fundamental. It is the job of changing sliding friction to rolling friction. Pushing a heavy book across a table illustrates the principle of sliding friction. If marbles are put under the book, sliding friction has been converted to rolling friction. A feather touch will then start the book moving.

In the early stages of the industrial revolution, the plain bearing or stationary bushing met the needs of higher speed and longer life in turning parts—up to a point. The point was that speeds of things could be increased only in direct ratio to improvements in bearing metallurgy and lubrication. Modern technology and the present age of super speeds waited on the development of bearings that would eliminate the rubbing friction of a moving part against a stationary one and substitute rolling friction. The solution came less than a century ago and at once removed many of the barriers to high speed, at least

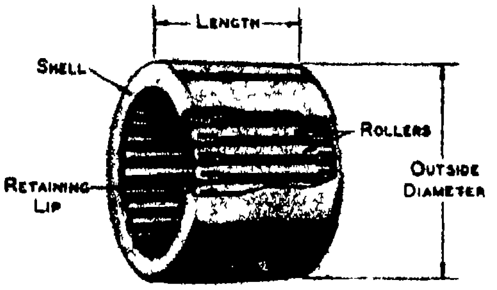
Linlithgow Imperial Agricultural







A few of the most commonly employed anti-friction bearing types. Upper left: Tapered roller bearing assembly. Above: Ball bearing assembly. Upper right: Straight roller bearing assembly. Left: Ball-thrust bearing assembly. Right: A needle bearing assembly



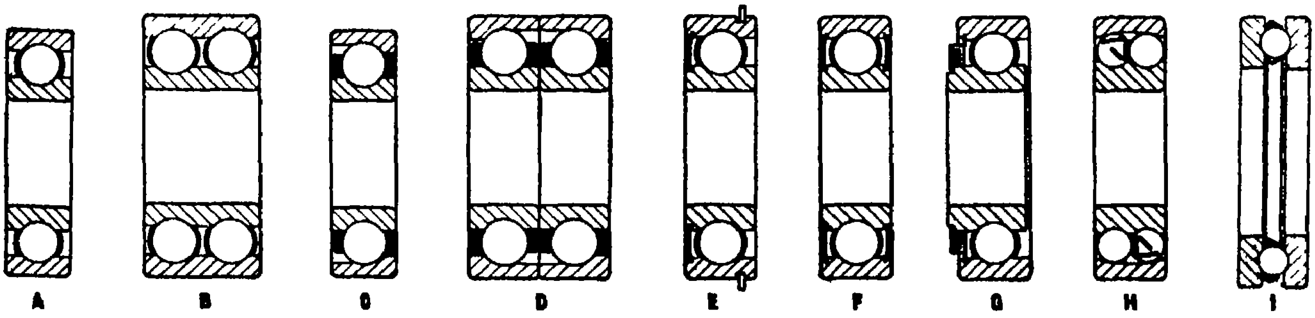
as far as the revolving parts of machinery were concerned.

Today, most machinery which must carry heavy weight or travel at high speeds depends on rolling friction, which is the closet man can come to no friction at all. Shafts, pulleys, pivots, axles, wheels—vital turning points—are protected by a ring of steel rollers or balls. No matter how complicated, no matter what technical refinements have been added, the anti-friction bearing is basically this: an outer ring or race in which a specified number of balls or rollers ride, a retainer or cage to keep the balls or rollers from falling out, and an inner ring to hold the shaft.

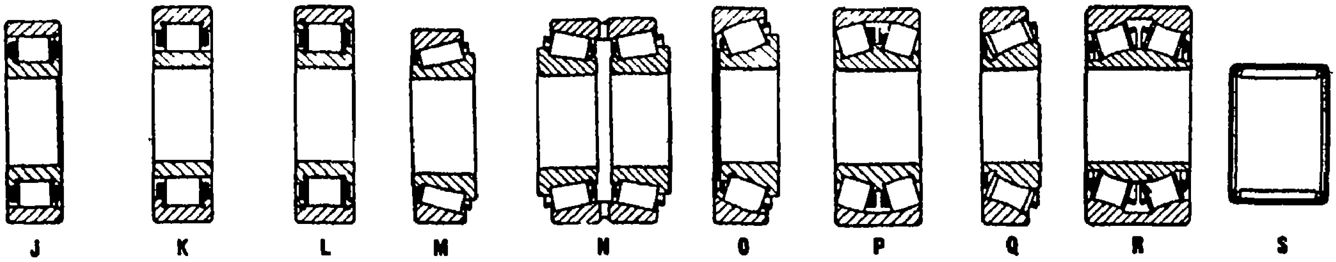
Most of the high speeds of the 20th Century are taken for granted. For example, the average vacuum-cleaner rotor spins at about 3000 revolutions per minute, a speed that would have been impossible on the plain bearings of 100 years ago and impractical even with many of today's plain bearings. The difference between the demands for speed and precision in the first and second world wars alone gave the makers of anti-friction bearings top priority in 1941—the enemy's plants as targets, our own as mainsprings of production. Thus the two most historic air raids, first Schweinfurt and then Hiroshima, were aimed at the heart of enemy bearing centers.

18,000 TYPES AND SIZES—Because there is such a great variety of anti-friction bearing from which to choose (18,000 types and sizes), the basis for bearing selection is often difficult for industrial executives and engineers as well as for students to understand. And because the application of anti-friction bearings is expanding at an enormous rate in all industries, a basic understanding of the various types and their functions becomes increasingly important.

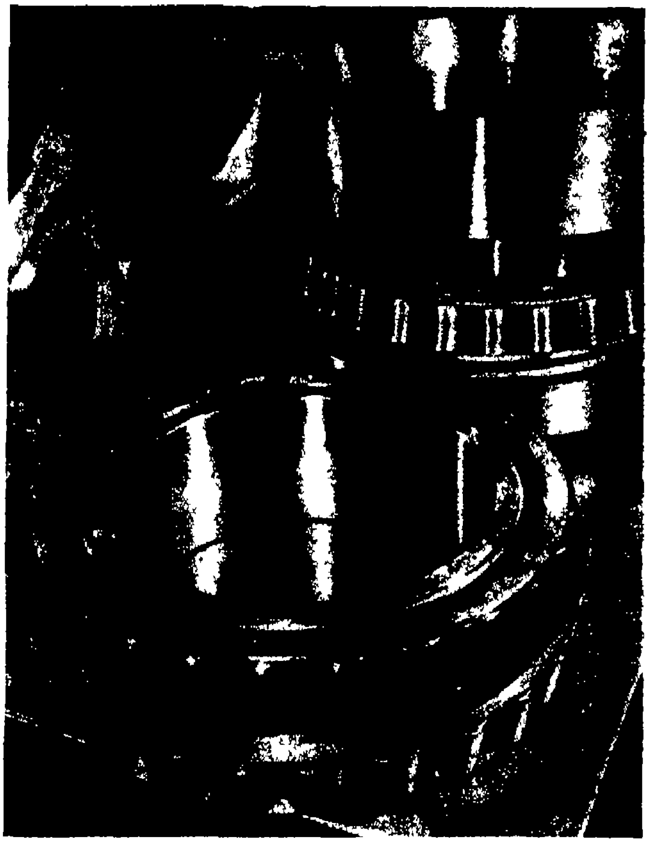
Consider, for example, the choice which confronts the designer or draftsman with a bearing problem. He can have angular contact bearings for thrust or combined thrust and radial loads, double row ball



Types of anti-friction ball bearings. A, single row; B, double row; C, radial thrust; D, duplex with faces ground for use in pairs; E, snap ring (used both with and without shields); F, shielded (shields may be on either one or both sides); G, single seal (sealed bearings may have seals on both sides, in which case they are wider); H, self aligning; I, ball thrust



Types of anti friction roller bearings. J, straight, separable outer ring; K, straight roller, separable inner ring; L, straight roller, non-separable; M, tapered roller; N, tapered roller, double row, adjustable through cones or cups; O, barrel roller; P, barrel roller, double row; Q, concave roller; R, concave roller, double row; S, needle, sometimes with separable inner rings



Roller bearings so large that a crane is used in assembling them

bearings, Conrad, or maximum type, roller bearings or roller needle bearings with or without self-alining features, and so on

In unraveling these seeming mysteries, it should be understood that there are relatively few instances in which basic anti-friction bearing types are not interchangeable Thousands of borderline cases exist in industry where conditions of load and speed, and other factors, permit a choice between ball or roller bearings And even where one bearing type seems clearly indicated, special designs or additions may make substitution possible Three different makes of machine tools of similar design may each respectively use a ball bearing, a straight roller bearing, and a tapered bearing in the same function

Railroad journal boxes are an exception All use roller bearings, although one type incorporates a ball bearing, too, to take up thrust The largest steel mill bearings for presses are invariably roller types On the other hand, in instruments which must function at high speeds and have room for only the smallest type of anti-friction bearing, ball bearings are the single choice

BALL-BEARING TYPES — Ball bearings are generally divided into three basic groups (1) deep groove bearings, used chiefly to support radial loads in a direction normal to the shaft axis, (2) angular contact bearings which are employed to sustain combined radial and thrust loads, and (3) thrust bearings which carry purely end-thrust loads In the first two types the component parts consist of an inner ring, an outer ring, and a retainer (sometimes called a separator or cage) which is used to space the balls apart Where the bearing is called upon to sustain extremely heavy loads at very slow speeds, a full row of balls without retainers is occasionally used The

Air conditioning protects tiny bearings during assembly and inspection

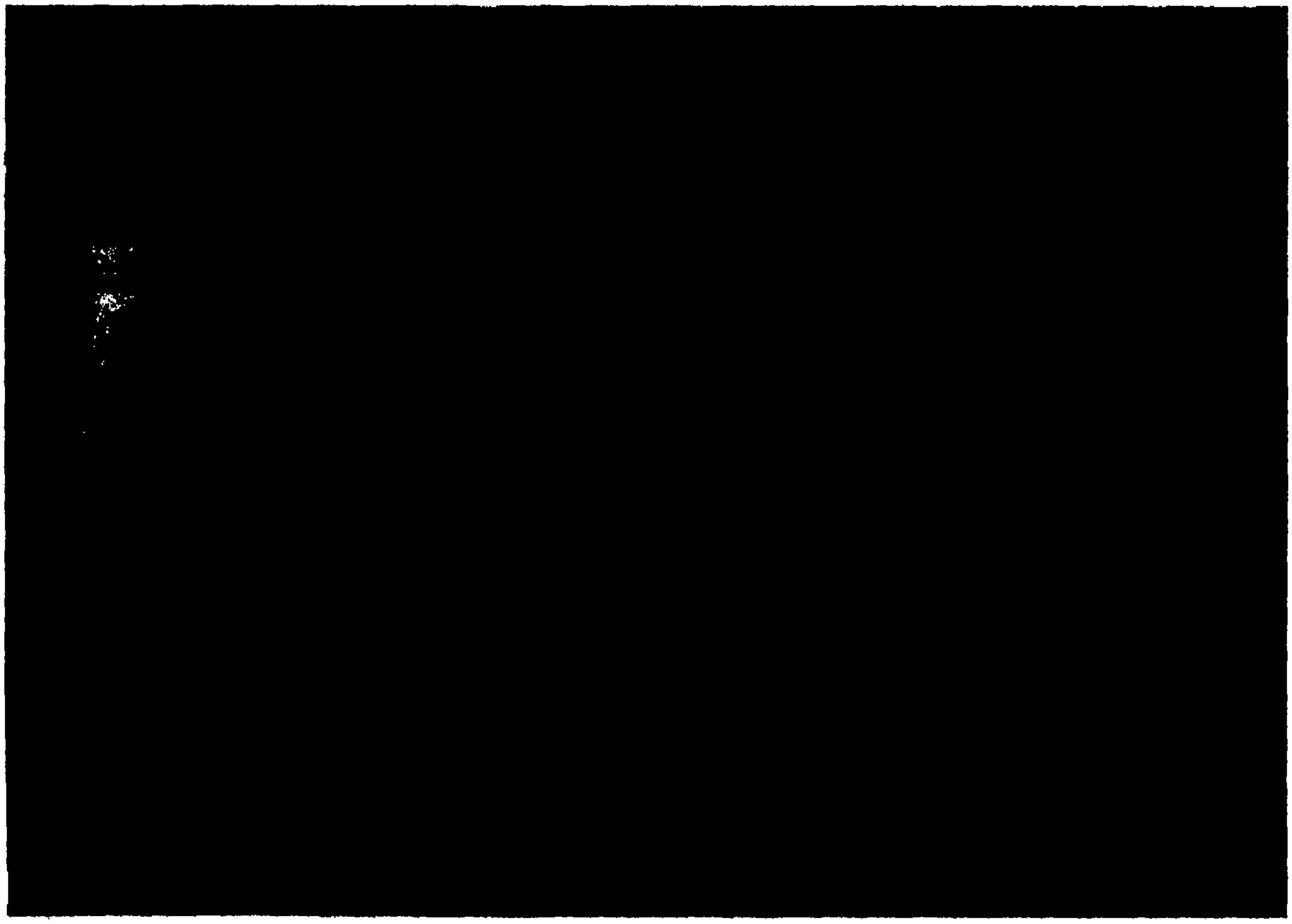
raceways of the inner and outer rings have curvatures which conform closely to the curvature of the balls, so as to provide the maximum load carrying capacity However, the raceway curvature is slightly greater than the ball curvature to reduce the friction between the ball and the sides of the raceway

For increased radial load capacity, ball bearings are sometimes made with two rows of balls, each row having its own retainer Another type of ball bearing designed to compensate for misalinement of the shaft with the housing has two deep raceways in the inner ring with the outer raceway of spherical form, the center of the sphere coinciding with the shaft axis The outer ring is therefore free to aline itself as required, without binding the balls in any way The load carrying capacity of such a bearing, however, is limited due to the small contact between the balls and the outer raceway

The range of speed at which ball bearings rotate varies from an almost imperceptible movement as in instrument gimbals to speeds of 100,000 revolutions per minute when used in small grinders employed in making dies In both extremes of speed, the highest degree of precision and smoothness of the raceways and balls is required. For continuous high-speed operation, retainers are frequently made of phenol-impregnated composition, accurately machined for good balance This material is light in weight and requires little lubrication, although it cannot be used at temperatures higher than 250 degrees, Fahrenheit. For moderate speeds, steel retainers formed in two halves and riveted together are satisfactory, and the majority of bearing retainers are of this type. However, retainers are sometimes machined from bronze or aluminum tubing, the latter material being desirable for aircraft bearings because of its light weight

Thrust ball bearings are usually made up of two plates or washers between which the balls rotate The washers ordinarily have grooved raceways, although flat ungrooved washers are sometimes employed for light loads One washer is mounted so as to rotate with the shaft while the other is stationary Retainers of machined brass or pressed steel are generally used to separate the balls The speed at which thrust ball bearings may be rotated is limited because of the centrifugal action which tends to force the balls outward, causing wedging

ROLLERS AND THEIR USES — Cylindrical roller bearings are designed mainly to carry radial loads, while tapered roller bearings and those of barrel and hour-glass form will withstand end-thrust as well as radial loading For low speeds, cylindrical roller bearings having rollers of a length several times their diameter may be used, but where speeds are higher, bearings having rollers of the same length as diameter give the best results When made to extreme precision, such roller bearings may be operated at speeds which approach those obtainable with ball bearings. Another form of cylindrical roller bearing employs a full row of rollers of exceedingly small di-



ameter, the roller diameter being about one eighth the length These are called "needle" roller bearings and they are used chiefly for slow speed or oscillating applications In many cases they run directly upon a hardened and ground shaft, thereby dispensing with the usual inner ring

Tapered roller bearings are made up of tapered rollers with a length about twice their mean diameter The elements of the cone of each roller, when extended, meet at one point on the axis of the shaft so that true rolling is obtained without slippage The rollers are restrained from moving outward by a flange with which the outer ends of the rollers are in contact The angle of the cone through the axis of the rollers varies in degree, being larger for applications where extra heavy loads are to be carried

Self-aligning roller bearings, designed to operate under conditions of misalinement, have one raceway, either the inner or outer, which is spherical in form and which conforms to the shape of the rollers Bearings employing rollers of barrel shape have the outer raceway spherical while those using hour-glass shaped rollers have the inner raceway spherical In both types the center of the sphere lies in the shaft axis Flanges on either outer or inner ring are used to guide the rollers

LONG SERVICE, LITTLE WEAR — Anti-friction bearings, properly lubricated and adequately protected against dirt and foreign matter, will show no appreciable wear even after long periods of service On the other hand, plain or sleeve-type bearings usually are shorter lived Anti-friction bearings can be replaced as complete units, ready for immediate service, requiring no special filing, scraping, or fitting operations Ball bearings in particular and also many types of roller bearings are made to established standards of exterior dimensions which are in use in Continental Europe and in the Western Hemisphere, so that bearing units are obtainable almost anywhere throughout the world, should replacements be needed

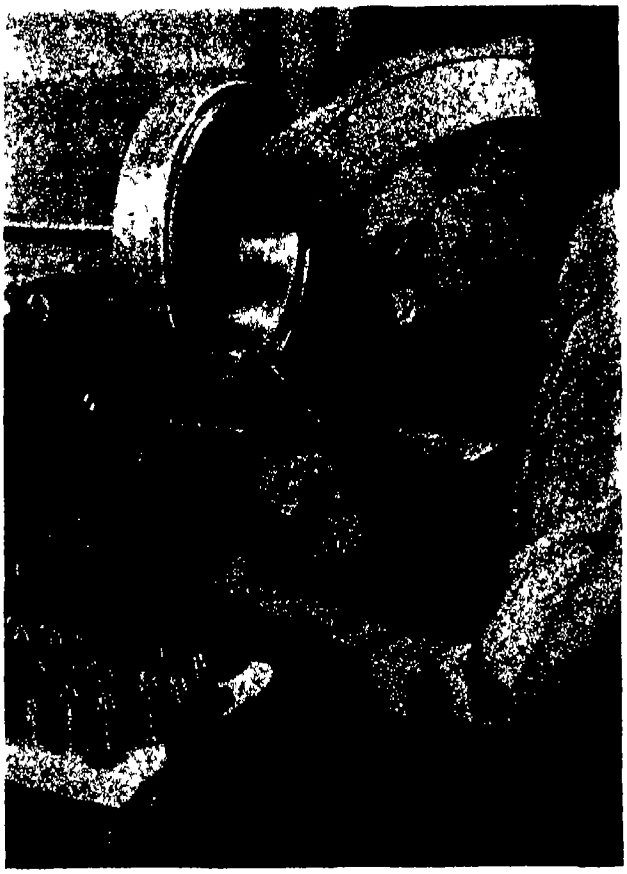
In recent years there has been an increased use of completely sealed anti-friction bearings, particularly in units where low manufacturing cost is essential These have flexible leather or felt seals or closely fitting, non-rubbing metal seals at each side of the bearing The seals retain the grease as originally packed into the bearings, and keep out dirt and foreign matter With the highly developed bearing greases now available, pre-packed bearings have been known to operate under normal conditions for three years or more without requiring re-lubrication

Over the years, the industry has added many new types, shapes, and forms to the original straight roller and standard ball bearing to answer specific needs Stack bearings in which several rows of ball bearings are merged together were an outgrowth of World War II and the needs of the aircraft industry The needle roller bearing is likewise a comparatively recent development in which slender rollers of unusual length are used for various types of shafts From the original roller bearings have also come barrel roller bearings—all of them tending to give the industry greater versatility

At present, the major research in the anti-friction bearing industry centers around four major goals Better lubrication, improved steels, increased straight-line precision, greater standardization In production of quality steel, the industry's record is so outstanding that it has given to jet plane research one of the few steels suitable to withstand the blast-furnace temperatures of jet engines Likewise, its research in lubrication has gone beyond its own problem and contributed knowledge and know-how to better greases for other moving parts

Anti-friction bearing manufacturers believe that the field of expansion for their products is virtually unlimited—that the saturation point is nowhere in sight and that it will not be reached until there is no longer a need for high-speed turning parts, durability, and trouble-free maintenance in machinery of all kinds

Opposite page:
Anti-friction bearings in the differential of an automobile. To the left of the pinion gear the drive shaft is supported by a double-row ball bearing; to the right of the same gear a double-row thrust roller bearing is used



Right:
In a sound-proofed room, a trained tester listens to bearings which he places, one at a time, on a rapidly revolving shaft. The slightest "foreign" noise is instantly detected and the offending bearing is discarded, even though the noise may be caused by only a fleck of rust or other minor defect

Sleeping Beauty of Industry

Silver, Long Tied to Currency Values, Can Become the Fair-Haired Boy of Industrial Engineering Metals Its Mettle Has Already Been Proved in the Brazing, Electrical, and Chemical Fields Future Expansion Will Depend Upon Price and Industry's Attitude

By Edwin Laird Cady

WHEN FINE silver got down to 60 cents a fine ounce (about $9 00 an avoirdupois pound), dozens of engineers rubbed their eyes, reached up on their shelves for the blue-prints of plans which had been gathering dust for years

At this price silver could be fabricated into many products at prices competitive with the high-alloy types of stainless steel If the price were to go still lower then any number of industrial uses of silver might become commercially practical And since there are some industrial uses for which silver is nearly indispensable, no matter what its price, quite a few industrialists could see money which had gone for high priced silver made available for higher wages to labor

Thus was resumed an engineering struggle which has been going on for centuries excepting when interrupted by wars

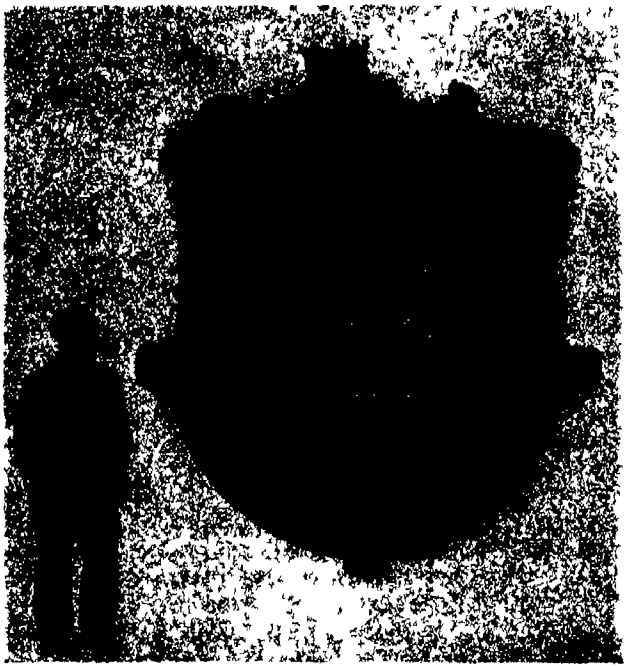
Mankind always has taken an ambivalent (cock-eyed) view of silver Seen out of one eye, silver is a basis of coinage, an article of costly table-ware and of jewelry, a by-product of copper and other mining, therefore, its price must be kept artificially high Glimpsed from an eye which the actions of governments have kept blackened for centuries, silver is a metal which has more on the ball than any other with the possible exceptions of iron and copper and therefore ought to be priced as low as the law of supply and demand will permit. Up until now, mankind has been unable to make up its mind But industrialists are hoping

Weather making is one of the uses for which the silver price would make no difference There has been plenty of publicity about dropping dry ice into clouds to cause snow or rain storms but not so much about the fact that silver iodide undoubtedly would do the job much better

FLOOD CONTROL — Scientists have calculated that, if the entire United States could be found blanketed by clouds at the same time, then only 200 pounds of silver iodide blown into the air from selected points on the terrain could cause simultaneous rain over every square foot of our nation. With silver iodide dispersed from airplanes, heavy storms might be broken up before they got well started, flood waters might be made to deposit themselves on arid desert regions before they got a chance to concentrate and swell the rivers

Silver brazing ("hard soldering") is another use which will find some employment almost regardless of silver price A silver brazed joint between most metals is second only to 100 percent welding in strength, and between some metals is stronger than welding The juncture is corrosion resistant and a good conductor of heat and electricity To counterbalance the high cost of the silver in the braze alloy there are such savings as the avoidance of the cost of machining fillets and grooves ahead of the braze, the elimination of final or "clean up" machining after brazing, the extreme ease of handling which lends itself ideally to induction heating or automatic gas torch heating or furnace or even salt bath brazing, and the low temperature (as low as 1140 degrees, Fahrenheit) at which the work may be done But wide spread as the possibilities of production-

The silver lining has an immediate cash value when the equipment is scrapped



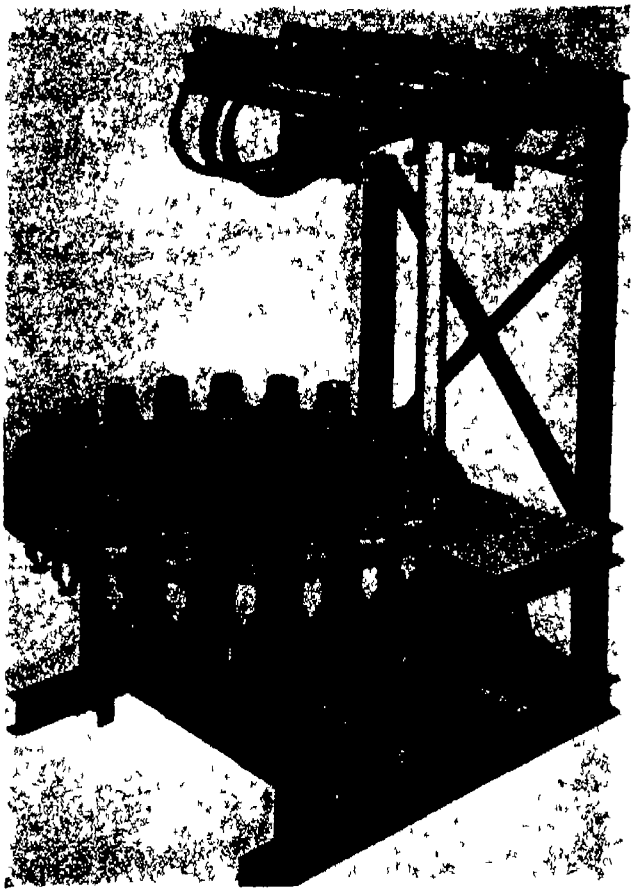
line savings may be, there still are thousands of uses of silver solder which will become economical only when the price of silver goes still lower

SILVER LININGS — On the fence in the price matter is the use of silver linings for chemicals and foods processing equipment

Such silver linings have a great deal to offer Anyone can find as many chemist's opinions as he wishes regarding the question of whether or not silver ever oxidizes at temperatures below its molten state, but certainly it does not oxidize very much and if at all then only at very narrow ranges of temperature It is not dependent, as are the stainless steels, upon a thin layer of oxidation to inhibit further oxidation and so it does not present an oxidized surface to liquids with which it is in contact

There are other advantages of silver linings Silver is the number one metal as a conductor of heat and electricity, it thus can contribute much to heating, cooling, and electrical processing Silver is one of the most readily self-healing of metals if attacked chemically at porous areas It can be electroplated on a surface, rolled to a highly homogeneous wrought metallurgical structure, and thus used as a thinner protective cladding than almost any other metal. And it is highly resistant to most acids and a long list of other corrosive chemicals

Parts set up for mass fluxing and silver brazing



Equipment for silver brazing with gas

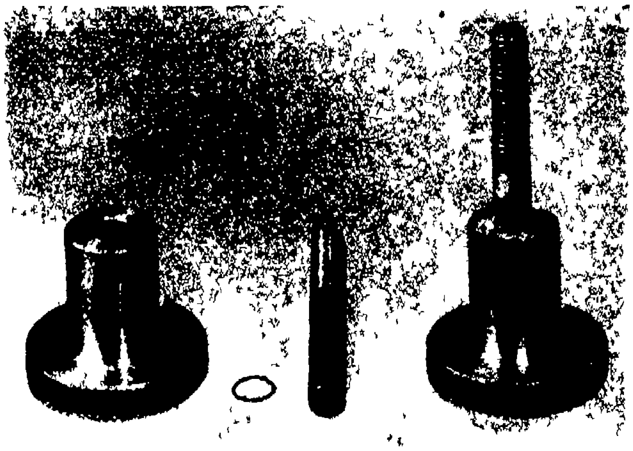
A price-wise argument concerns the value of the silver lining as an investment Many a chemicals house has bought huge silver-lined kettles and vats, extensive installations of silver-lined faucets and pipes, with the idea that when the equipment wore out the silver linings would be money in the bank On such a financial basis depreciation need be charged only on the iron or other common metal parts of the equipment, only interest on the investment being charged against the silver More than one company bought silver-lined equipment during the depression, scrapped it during the war, and got more for the silver linings than the complete equipment had cost

Let the price of silver go down severely, and many a brand new depreciation entry will appear on capital equipment books

And yet, as always, there is the opposite picture of highly valuable contributions of silver if the price goes down The oligodynamic use is an example

IONS HUNT MICROBES — "Oligodynamic" means in simplicity, that a silver lining on a vessel has the ability to shoot silver ions into the liquid within the vessel, and these ions will go hunting for microbes the way old-time privateers used to hunt down enemy merchant ships

Industry does not know as much as it would like to about this oligodynamic business The price of silver never has been low enough to warrant much commercial development Research has indicated that the ions may not be too effective against the



A micrometer screw costs less to make in two pieces and silver braze than to machine from the solid

• LOOKING AHEAD •

New views of silver as an industrial metal
Expansion of silver brazing
Silver-plated vessels replacing pasteurization process
More uses in electrical industry
Better magnets
A changing attitude toward quoting silver's price

kinds of microbes which are high in protein or are protected by devices which under the microscope look like long hair But research also shows that plenty of other kinds will be reduced to the minimum in the liquid contained in a silver-lined vessel And if the action is effective it keeps on being effective for a long time A water glass which has had only a tiny bit of silver in it can be refilled again and again and enough of the silver will cling to the glass walls so the ions will continue to shoot out, killing the microbes at each refilling

Cans for orange juice, for malt beverages, and other liquids have been given extremely thin silver linings and found effective for long period storing and shipping Pasteurization, which reduces the palatability of some liquids, may some day be eliminated in this way But these benefits will be commercially rare unless reduced prices of silver make them practical

The electrical uses of silver offer another cost dilemma Silver contacts are highest in electrical conductivity, conduct heat away from contact surfaces and thus tend to prevent troubles from overheating, are not oxidized by the ozone which so often is present within electrical equipment If corroded they are likely to form compounds which are high in electrical conductivity and therefore the corrosion damage is slight In many cases, no substitute for silver contacts is considered, almost regardless of price

Silver brushes in electric motors, even when the silver be mixed with carbon, have an ability to impart an extremely thin silver coating to rotating parts against which they bear This coating has virtually the same conductivity as silver, of course, and therefore the voltage drop between the brush and the mating surface is very little Aside from other advantages, this property alone has caused wide-spread use of silver in brushes

SILVER OFTEN LESS COSTLY — Many an engineer has been astounded to learn that, kilowatt for kilowatt of capacity, silver often is a less costly form of electrical wiring than is aluminum And the fact that silver can be fastened to spring steel parts without drawing their spring tempers, and hard or soft soldered to almost any metal, offers advantages of fabrication costs which electrical device makers can't ignore But with all this there is many an electrical need which silver cannot meet unless price goes down

Magnets are an example An alloy which contains about percent of silver can be made into a permanent magnet which can be much shorter in length than any other magnet alloy for the same flux But in spite of the obvious savings in space and weight to be obtained with this alloy it is recommended only for "special" uses, the other alloys being more economical for the majority of purposes

Silver as a lining for bearings is high in lubricity and embeddability, does not melt readily, can conduct away the heat of friction Silver as a catalyst is highly valuable to the chemical industries Silver as an alloying ingredient in metals can promote machinability and add to corrosion-resistant qualities Silver is the most weldable of metals, when methods are perfected for welding at room temperature and by means of pressure and time alone, the first metal to be used will undoubtedly be silver Silver as a chemical ingredient is irreplaceable for many uses

In the face of all these advantages mankind has to make up its mind whether to turn silver loose on the open market or keep it tied to currency values But in the present industrial picture perhaps the greatest need is to quit quoting silver on the basis of ounces "Nine dollars a pound" sounds like an industrial metal, "sixty cents a fine ounce" has the ring of a jewelry or drug store purchase

Silver lined bearings are high in lubricity and embeddability

PARADOXICAL Paints

Surface Coatings With Bases of Silicone Resins Possess Many Seemingly Impossible Combinations of Opposing Qualities

By James R Patterson
Engineering Section, Resin and Insulation Materials Division Chemical Department
General Electric Company

A SINGLE silicone paint may resist both high and low temperatures, may withstand exposure to both acids and alkalies, and may be hard as well as flexible And it is this combining of such apparently opposite characteristics in a single paint that holds the secret of the growing importance of silicone paints

The silicones are characterized by an unusual inertness to physical and chemical change over a wide range of conditions This inertness can be attributed to a basic chemical structure of recurrent alternating atoms of silicon and oxygen, a structure similar to that existing in glass and quartz. The flexibility, toughness, and workability of the silicones come from built-on groups of carbon and hydrogen atoms All of this is in marked contrast to the less inert but more familiar hydrocarbon structure based on chains of carbon atoms

Today's silicone products range from gases and volatile liquids through oily fluids and greases to plastic resins and elastomers And it is these resins and elastomers that are attracting great interest as bases for paints, lacquers, enamels, and similar types of surface coatings

In making finishes and coatings with these silicone resins, the same equipment and techniques as used with other binders may be employed Pigments are dispersed in them with ball or roller mills, metal salts such as those of cobalt, iron, or zinc are added to catalyze curing, and common aromatic and aliphatic solvents thin the resulting mixtures for more convenient application

The coatings may be applied by spraying, rolling dipping, or knifing Then for the most satisfactory results they should be baked or cured at 400 degrees, Fahrenheit, for 30 to 60 minutes As yet no entirely satisfactory air-drying silicone paints have been designed, unless baked, they are lacking in toughness, adhesion, and weather resistance

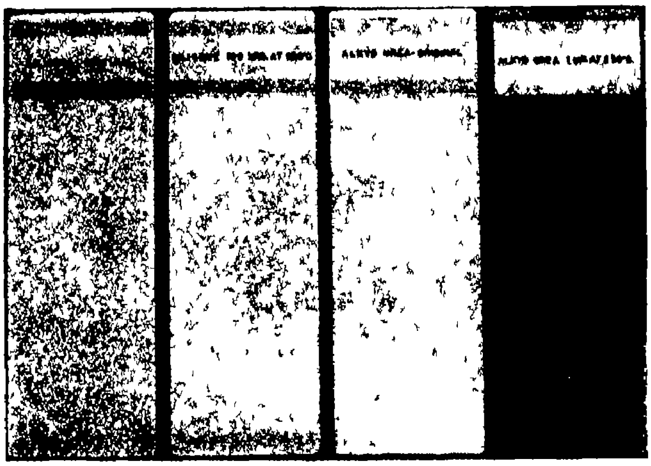
It might be said that the finishes made with silicone resins possess many of the desirable characteristics of both vitreous or porcelain enamels and organic polymers Fortunately, this end result is accomplished without an outcropping of the undesirable characteristics of the individual members, as so often happens with blends of other resins

RESISTS HEAT, KEEPS FLEXIBILITY — While silicone enamels will not withstand as high temperatures nor provide as much abrasion-resistance as porcelain enamels, they do permit the attainment of new levels of heat-resistance along with flexibility They may be exposed to 500 degrees, Fahrenheit, for months will little or no change in color and gloss, and with only a negligible loss of flexibility and adhesion Some types may be held at temperatures of 600 to 700 degrees, Fahrenheit, for several hours, but at these temperatures there is a gradual loss of the resin through volatilization Beyond a certain point in this loss, the film has lost enough binder to be brittle, and may crack from shrinkage Color change does not accompany this film failure

Thermoplasticity, or softness when hot, is an objectional trait of the more heat-resistant organic finishes Thermo-cured silicone enamels are markedly superior in this respect, even though they do not have the abrasion resistance at high temperatures that porcelain enamels possess And these same silicone enamels retain their flexibility and adhesion at temperatures as low as 60 degrees below zero, Fahrenheit To attain this with other types of materials, usually a sacrifice in hardness at normal temperatures must be accepted

The semi-inorganic nature of silicone resins would be expected to display itself in low flammability and resistance to burning This is so, but to varying degrees, depending on the content of organic modifier Generally they will burn when in contact with a hot flame, leaving a residue of silica, but it is difficult to set them afire with a lighted match

RESISTS ACIDS, ALKALIES — General chemical resistance constitutes another silicone plus-value This is evaluated by applying films on the outside of large glass test tubes which are then immersed in baths of various reagents at set temperatures Silicone finishes are not affected by exposure for several hundred hours in 5 percent solutions of



Coated test panels before and after exposure to heat. Left to right: Silicone painted panel before test; silicone painted panel after 100 hours at 250 degrees, Centigrade; alkyd-urea coated panel before test; alkyd-urea coated panel after exposure for only one hour at 250 degrees, Centigrade

• LOOKING AHEAD •

Exterior surface coatings which are virtually unaffected by weather . Easily cleaned heat-resistant surfaces resisting chipping throughout a wide range of temperatures Automobile paints far outlasting those in present use Direct competition with conventional paints

caustic soda, or of acids such as hydrochloric, sulfuric, or nitric, at 100 degrees, Fahrenheit, but at their present stage of development they fail in a few hours in concentrated solutions Also, they strongly resist materials that they might encounter in kitchens, laundries, creameries, bakeries, breweries, and hospitals—for example, such materials as fruit and vegetable juices, mayonnaise, mustard, vinegar, cooking fats, soap, alcohol, lactic acid, iodine, and mercurochrome Another factor which cannot be overlooked in finishing equipment for many of these uses is whether the coating will support mildew and other fungoid growth Alone, silicones will not support such growth When mildew grows on them, it is being supported by foreign material

This brings cleanliness and its maintenance to mind The silicone paints can be formulated to have a very smooth, slick surface to which foreign matter does not readily adhere, and which can be easily wiped clean

One practical application of this slickness is in coating molds to prevent molded articles from sticking For instance, bread pans coated with silicone varnish never need greasing to prevent the bread from sticking, these pans can be used for several hundred bakings before they need re-coating Apparently this coating has no deleterious effect Its adherence to the pans is sufficient to avoid contamination of the bread, also, while the non-toxicity of silicone coatings has not been entirely established, there is much evidence of their being physiologically inert

In the food canning industry there has long been a need for an improved coating which will withstand exposure to the boiling water and wet steam used for sterilization It is believed that silicone coatings will stand up well under these conditions Laboratory tests with samples suspended in the steam and partially immersed in the boiling water have been run for as long as one hundred hours without failure

RESISTS WEATHER — Resistance to weather is not one of the least important assets of silicone paints Determining weather resistance is a long-time affair but preliminary evidence again attests to unusual inertness, and indicates a long life span graced with a lasting appearance of newness Several accelerated exposures of silicone paints have gone four years and more with no apparent deterioration Control exposures of other durable coatings available at the time the tests were started already show considerable failure Depending on the color, they have either chalked and faded or cracked and checked The silicone paints containing durable pigments still maintain their original gloss, color, and film integrity Some of the softer types exposed in industrial areas have collected an adherent coating of atmospheric dirt and dust, harder types seem to have shed this dirt readily Many pigments which are considered unsuitable for outside use in other binders stand up very well in silicone resins

The method of accelerated testing used for the above weather-resistance observations is as follows Steel or other metal panels are thoroughly protected with a corrosion-inhibitive primer Then the paint to be evaluated is coated over the primer, usually two coats are applied These finished panels are placed in specially designed outdoor racks so that the panels are at an angle of 45 degrees from vertical, and facing southward This position insures that a maximum of direct sunlight reaches the coating Exposures are made in various geographic localities to ascertain the effects of cold winters, hot summers, sudden drenching rains, seaside salt air, and industrially contaminated atmospheres These particular tests are being made in Florida and New York In addition, tests are being run in weather-simulating devices Results here are unusually good, too

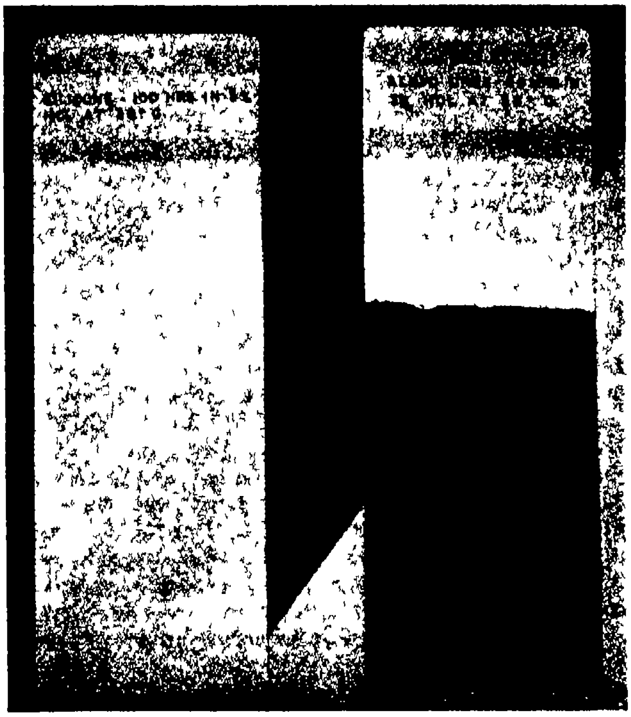
Weather resistance as shown by silicone paints immediately suggests their use on automobiles Until recently their tendency to re-dissolve in high-test gasoline was much against this application, a careless service station attendant might overflow or spill gasoline and badly damage an automobile's finish Now silicone paints can be designed to be suitable in this respect Also, these same paints will safely resist radiator anti-freeze mixtures, hydraulic fluids, and lubricants

CURING IS PROBLEM — However, one of the important requirements for finishing such products as automobiles has not been fully met by silicone paints so far This is the ability of the finish to be air-dried or baked rapidly at moderate temperatures. For refinishing used automobiles, an air-drying coating is desirable For production-line finishing of new models, speed is essential, and some parts should not be subjected to temperatures above 250 degrees, Fahrenheit As mentioned above, air-dried silicone paints are not durable and relatively high baking temperatures must be used to bring out their superior qualities. Some success has been obtained with curing at 300 degrees, Fahrenheit, but this requires the rather impractical time of two to three hours A temperature of 400 degrees, Fahrenheit, is much more suitable for producing hardness and general resistance characteristics, at this temperature 30 to 60 minutes is required Fifteen to 30 minutes at 500 degrees, Fahrenheit, produces equivalent results

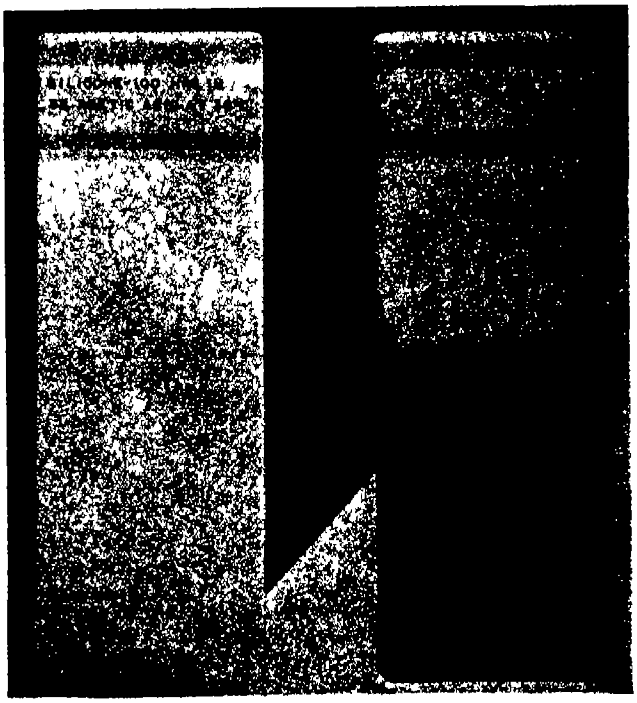
With the advances that have already been made in speeding up the curing of silicone paints, further improvements will not be surprising It may be that even before this is published, modified resins will be designed and new catalysts discovered to decrease making temperatures and times by as much as one half, and air-drying types are theoretically possible

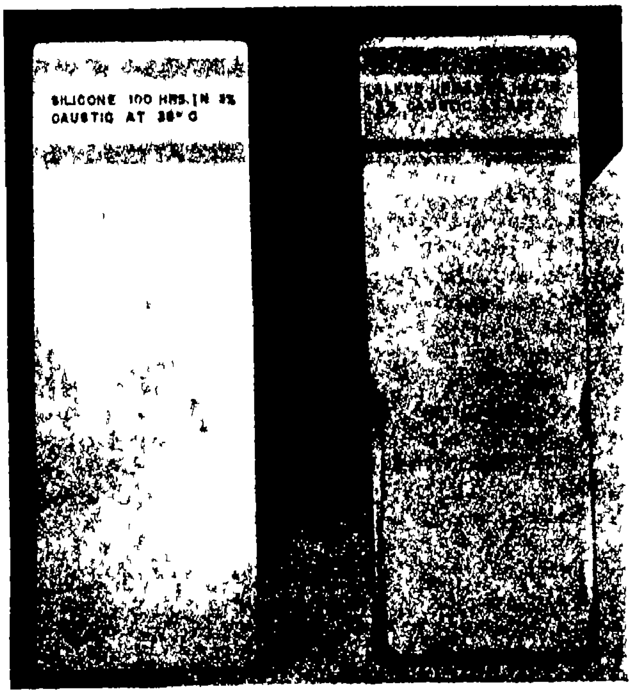
PRICE LIMITS USES — As for most new chemical products, cost and limited production capacity are the main factors restraining silicone paints from wide general use today But there are many special applications where their present high cost of as much as 20 to 25 dollars per gallon is no barrier For example, in finishing stove, heater, and kitchen-range parts where heat-resistance is essential, and no other finish except porcelain enamel is satisfactory, it is economically desirable to use silicones The high application cost, the necessity of using special steel, the high rejection of imperfect pieces, and the difficulty of repairing damage with porcelain make silicone enamels more than competitive

There are many other uses where the characteristics of silicone paints are desirable, but their present price is too high However, the additional manufacturing facilities which will be completed this year should bring the cost to the level demanded for these uses Then there is also the type of use where other paints are satisfactory, or nearly so Here price is all-important, and possibly as long as ten years will pass before silicone paints can be used economically However the time is not too distant when production experience and quantity production should aline these new paints competitively with all others of good quality



Panels coated with silicone and alkyd-urea paints, as they appeared after being subjected to tests indicated by lettering at tops of the panels





SEEING • IS Believing

Industry Is Turning More and More to Motion Pictures to Solve Tough Sales Problems Here Is How One Manufacturer Used This Graphic Medium to Break Down Consumer Incredulity in the Capabilities of His Products, and also to Present Instructions For Their Use

By Carl Toll
General Advertising Director,
The Sherwin Williams Company

FROM the very beginning, when we began to market Pestroy DDT and Weed-No-More 2,4-D on a national scale, we realized our biggest single job was to educate our dealers and the consumer to the advantages and uses of these new scientific achievements

Last year millions of Americans laughed when they saw their neighbors walking around their yards spraying weed-killers on the lawn It seemed too fantastic to be true that you could spray weeds away It was this kind of resistance we faced when we marketed Weed-No-More No one could blame the consumer for his attitude Even many of our dealers doubted the claims we made for the product They were just as skeptical about our claims for DDT when we announced that we had a DDT product which would stay lethal for a period of 60 to 90 days Our dealers wanted proof—and so did the consumer

We decided the best way to prove our story was to produce a movie for each product, in which we could visually show the actual results of the products in action Movies, we felt, had additional advantages We could actually show our dealers and the consumer how and where to use the products, and we knew from Army reports that the retentive value of movies was far greater than that of the printed word

Once this was decided, our next step was to select a studio Since the products dealt with new scientific developments which were comparatively unknown, we felt the studio which did our job should have had previous experience in this type of work The studio we selected (Jerry Fairbanks, Inc) had a fine record in turning out two-reelers on scientific subjects which met with popular acceptance

In presenting the story of the development of Weed-No-More we wished to make clear several important facts 1 That 2,4-D was the first positive advance in the killing of weeds since the beginning of time 2 That 2,4-D actually killed weeds—roots and all 3 That it was effective on hundreds of varieties of weeds

TECHNIQUE USED — We solved the first problem by using cartoon strips which graphically portrayed man's battle with weeds through the ages until the present day Proof of the actual killing power of 2,4-D was achieved by making delayed-action pho-

Scenes from two motion pictures, made to present facts about consumer goods and to tell how to use them. ABOVE: From the movie on a weed-killer. RIGHT: From one on a new DDT product. In both, cartoons combined with "live" shots give emphasis and dramatic appeal

tographs at 15-minute intervals over a period of three weeks of a weed that had been treated with Weed-No-More The process was repeated several times to show the action on the most common weeds

To give the story popular appeal, the whole film was woven around a family situation where the man in the house was delegated to weed his lawn by hand on a Saturday afternoon In disgust with the slow progress of the job, the husband, (Donald Woods) storms into the house and protests to his wife (Wanda McKay) that on Saturday afternoons "I play golf" On the golf course, Woods learns about Weed-No-More from the groundskeeper who is using it on the fairway At this point, the technical pictures were stripped into the film The movie ends after Woods uses the product on his own lawn and is amazed with the results

The film on DDT, called "Doomsday for Pests" is principally a cartoon-type feature with real models coming on the scene when the many uses of the product are shown In dealing with insects, it was felt the cartoon-type lent itself to much better treatment of the subject Close-up photographs which give actual proof of the lethal effects of DDT were also employed The scene is set in "Bugville" where it has just been announced that millions of insects have been wiped out by a Pestroy attack The bugs then rush to Bugville's theater where they see a newsreel on Pestroy DDT The newsreel traces the development of DDT, its uses in the war, and shows with micrographic photographs exactly how it works

CONCRETE RESULTS — Dealers throughout the nation were contacted upon completion of the films and told how to order prints for showing at their stores, or at clubs and fraternal groups in their community The response to the films has been so great and the word-of-mouth advertising so effective that today we have 350 prints in continuous use from coast to coast Our best estimate is that more than 1,000,000 have seen the films since their release eight months ago The real proof of their effectiveness can be judged in two ways Did they make our dealers better salesmen for the products, and did they produce sales? Evidence from all sections of the nation confirms our belief that these films were worth every penny of the investment For example, on the Pacific coast, a showing in Santa Rosa, California, netted $550 in sales on the spot, another in San Jose resulted in the sale of 45 gallons of Weed-No-More for use on neighboring golf courses

In the East one dealer wrote "These are excellent pictures I wish to compliment your company on the type of picture and production They are instructive and educational as well as interesting, and I know were much enjoyed by all"

The Michigan Extension News reports the following concerning the films "These films which describe the use of DDT and 2,4-D in an entertaining and story-like manner have been previewed and approved by Michigan State College"

In May our Southwestern District alone reported that the film had been shown 739 times At that time it was reported these showings resulted in $19,936 in on-the-spot business

In general, the results from these movies, which are the first full-color movies we have ever used in this manner, have been gratifying

FUELS OF THE FUTURE

The Petroleum Industry Looks to Atomic Power for Valuable Assistance in Supplying Fuel Demands in the Years to Come Liquid Fuels in Improved Forms, Obtained From Crude Oil and Synthesized from Coal, Vegetable Matter, and So On, Are Expected to Furnish Power for Still More Efficient Transportation Units

By Robert P. Russell
President, Standard Oil Development Company

Editor's Note: **The accompanying article is the last of a series of four, adapted by permission from papers presented at a recent Standard Oil Company (N J) seminar on Fuels of the Future Each paper deals with different phases of fuels for engines of types now in use, under development, or projected Together they summarize the general subject and furnish a glimpse of the fuels and engines which technology will be offering to transportation in the years to come**

AS THE future is viewed through the eyes of the petroleum research scientist, certain trends are seen which will undoubtedly influence our activities for at least the next decade Foremost among these trends is the growth in world demand for liquid fuels The percentage of total world energy supplied by petroleum has jumped from 16 percent in 1925 to about 30 percent today A few figures illustrate this trend In 1914 only 4 percent of the world's merchant fleet tonnage ran on oil. In 1945 over 75 percent was oil-burning The horsepower from petroleum installed in the United States increased from 5½ million in 1935 to 45 million at the end of 1945 The war provided a striking example of our dependence on oil for energy A typical military division in 1918 had 4000 horsepower behind it, but in 1945 the horsepower of a mechanized division exceeded 187,000

Or the world picture may be scanned from the point of view of oil consumption prospects The per capita consumption of oil in the United States is 9 35 barrels per year World consumption per capita is 0 33 barrel The difference is tremendous If the rest of the world were to attain the same consumption rate as the United States, the petroleum industry would have to produce almost 19 billion barrels of oil per year to meet demand Or take gasoline Per capita consumption in the United States is 3 97 barrels, whereas the world per capita figure is only 0 12 barrel. To bring world consumption to the same relative position as the United States would require over 8 billion barrels of gasoline per year, or roughly 15 times this country's present production

Of course, the rest of the world will not attain the level of consumption in the United States for many years—if ever But as industrialization proceeds throughout the world, consumption will increase in proportion The demand for oil products today is unprecedented, surpassing even the peak war year And all our estimates foresee further pronounced increases

ATOMIC ENERGY A HELP — These figures have extreme significance to those of us engaged in petroleum research They mean that our efforts will be directed toward achieving economy through efficiency in use, and toward development of synthetic substitutes We also assume that other energy sources will come along from time to time to take some of the load off the oil industry Atomic energy is a promising source, but it seems most unlikely that atomic energy will be used for powering automobiles or aircraft However, there is no reason why it should not eventually find application in large stationary power and heating units, and possibly even in large ships Atomic energy would remove much of the current strain on oil, and the oil industry looks to atomic power for welcome assistance

Our liquid fuel research has made us consider not only new engines and new materials, but even new concepts of combustion itself The combustion problem is almost entirely mechanical In other words, if satisfactory mechanical means for mixing the air and fuel at or before the point of combustion are provided, then there seems to be no limiting restriction on how much fuel can be burned in a given space or on how well it will burn Therefore, the mechanical construction of burners plays an important part, and burners, whether for an ordinary household lamp or heating furnace or for a modern jet propulsion engine, must be adequately designed Nevertheless, the basic phenomenon of combustion is fundamental, and knowledge of the mechanism of combustion is essential Knock in the automobile engine, roughness in the Diesel, and carbon deposition and other objectionable features in household

Typical of the progress made in oil refining equipment is this set up of pipe lines and fractionation tower of the most modern still at the Baton Rouge refinery of the Standard Oil Company (N. J.). This still refines more crude per day than any other unit at the refinery

heaters and gas turbines are the results of poor or uncontrolled combustion Our laboratories, therefore, have under way as a continuing project fundamental studies on the nature of combustion

Much of our fuel research is tied in with developments in the automotive field We think that here the trend will be in the direction of smaller, lighter, reciprocating engines of higher compression ratio Trends in aircraft engine design are already pointed strongly in the direction of turbo-jet propulsion

Higher compression ratios in automotive engines will naturally require higher quality fuels The oil industry can produce these higher quality fuels today, and will be ready when the automobile industry designs and sells cars capable of taking full advantage of them Gasolines can be made today, with existing equipment and by processes already fully developed, to operate in cars with engines of 10 to 1 to 12 to 1 compression ratio, as against the present average compression ratio of slightly over 6 to 1

MORE MILES PER GALLON — From the standpoint of John Q Public's pocketbook, these figures have a very real significance A car giving performance equal to the best obtainable from present-day models, but designed to take full advantage of these new high anti-knock gasolines, would show a real gain in miles per gallon. For example, today's 6 5 to 1 compression ratio car will make, let us say, 16 miles per gallon at 40 miles per hour on a level road A car fully designed for a 12 to 1 compression ratio engine would make 24 miles per gallon This is an improvement in mileage of 50 percent The motoring public may, therefore, look to a saving in its annual gasoline bill and the oil industry to a conservation of supplies Experts in the automotive industry have stated that new cars with such high-compression engines can be built for no more than the cost of present-day cars

The introduction of the turbo-jet engine for aircraft might pose a problem of fuel supply, particularly in the event of a national emergency, when upwards of 1,000,000 barrels per day, or roughly one fifth of this country's present total refining capacity, might be required However, a review of one of Jersey's refinery facilities has indicated that, if specifications were adjusted to permit the inclusion of certain gasoline fractions, a yield of over 50 percent on crude could be realized This would provide almost three times the amount needed to meet any emergency volume requirement and, accordingly, fairly liberal protection would thereby be afforded to the manufacture of needed quantities of refined oil, Diesel fuel, and motor gasoline of satisfactory quality Engine builders are being encouraged to design future turbo-jet engines around such a prototype fuel, and it is expected that tentative procurement specifications encompassing fuels of this broad type will soon issue from the military

It is interesing to contemplate the other changes that gas turbines may cause in refining At the present time we generally assume that, speaking in round numbers, 43 percent of a barrel of crude will go into gasoline, 6 percent into kerosine, 14 percent into gas oil and distillate fuel, 24 percent into residual fuel, 3 percent into lubricating, and 10 percent into heavy products such as tar and asphalt Obviously, turbo-jet fuel demand will increase the need for middle distillates, probably at the expense of heavy oils, for there is little doubt that the demand for gasoline will remain high, and most of the additional requirements for jet fuel will have to be converted from other parts of the crude

This will not be a difficult technical problem for the oil industry, for over the past 15 years or so we have learned so much about hydrocarbon chemistry, and our refining processes have become so flexible, that we can produce almost any proportion of any oil fuel we choose from a barrel of crude—provided always that the necessary refining equipment is installed We could turn the whole crude into gasoline if we wanted to In fact, we can perform the modern miracle of producing a barrel plus two gallons of gasoline from one barrel of crude oil The additional volume is made up of the hydrogen added to the crude in converting it into gasoline We can even take a barrel of asphalt from the street and turn that into gasoline, too At present, of course, these processes are uneconomical, but they are possible

LIQUID FUEL SYNTHESIS — In looking to sources for the fuels of the future, we no longer confine our search to petroleum alone We know how to make liquid fuels from coal or gas just as readily as from oil For that matter, we know how to make liquid fuels from potatoes, sawdust, cabbages, and grain Most of these synthesis processes are not economical today, but in effect we have taken out scientific insurance against any reduction of our crude oil supply in the future I can definitely say that the United States need never be without liquid fuels—and at reasonable prices

A considerable part of the present research and development effort in our Company—nearly one third, in fact—is directed to obtaining liquid fuels from sources other than petroleum The emphasis being placed on this field is not due basically to any fear of future oil shortage Competent oil geologists have estimated that proved reserves of crude oil will be as great 20 years from now as they are today, or even greater But the cost of finding and producing petroleum is increasing, and this has already imposed on the industry the need for more efficient refining methods It has also brought us within sight of the point where liquid fuels from gas, coal, and other products will be directly competitive with petroleum products

COAL GREATEST POTENTIAL SOURCE — Our very greatest potential source of liquid fuels today is coal And research results to date make at least rough estimates of costs possible, even though no plants have yet been built Largely because of the large plant facilities required, the estimated cost of synthetic gasoline from coal is today higher than the cost of gasoline from crude oil For example, a plant to produce about 9000 barrels of gasoline per day from coal, together with about 1800 barrels of Diesel fuel or gas oil, would, we believe, cost about 60 million dollars In addition to high octane motor gasoline and Diesel fuel products, this plant would also yield nearly 40 million cubic feet a day of high-heating-value gas, which in Eastern industrial areas and some parts of the South sells for about 35 cents per thousand cubic feet At this figure, and allowing suitable credit for the Diesel oil and certain chemicals produced, the cost of gasoline from this plant, with coal at $2 50 a ton, comes to approximately 10 cents a gallon This does not greatly exceed the cost of producing similar quality gasoline from crude oil at present crude prices The plant investment, however, is several times as much, and the figure of 10 cents a gallon does not include any return on the added investment But even with a fair return on the greater investment, American motorists could operate their cars on synthetic gasoline from coal at an average additional cost of not more than 10 cents a day

We are much closer to producing liquid fuels from natural gas on a commercial scale Two natural gas conversion plants are under construction right now one in Texas and the other in Oklahoma According to our most recent estimates, a hydrocarbon synthesis plant erected in the United States to produce 10,000 barrels per day of hydrocarbon liquid products from natural gas, although costing less than a plant designed to make the same amount of liquids from coal, will still cost over twice as much as a complete refinery capable of producing the same products from crude oil Of the 10,000 barrels per day of hydrocarbon synthesis products, roughly 9200 barrels per day will be gasoline and 800 barrels per day will be gas oil There will also be produced about 845 barrels per day of oxygenated water-soluble products consisting largely of alcohols By assigning reasonable values to the by-products, and charging natural gas at 5 cents per 1000 cubic feet, the cost for gasoline from natural gas becomes somewhat less than the present cost of gasoline from petroleum

New engine developments and better fuels will, in effect, add extra billions of crude to our petroleum reserves by enabling us to save and conserve our oil resources Future developments in hydrocarbon synthesis, already under way in pilot plant stages, will enable us to extract liquid fuels from natural gas and coal to meet the ever-increasing world demand for sources of energy and industrial power And if the need for gasoline and fuel oil is ever great enough, and petroleum and natural gas and coal cannot supply it, we can make those fuels from potatoes, sawdust, cabbages, and grain

We expect that atomic energy for ships and stationary power plants will be developed in time to take its share of the energy-supplying load from oil fuels, allowing the oil industry to concentrate on products for automobiles, airplanes, and other small, compact power units

We believe that the fuels for these future transportation units will be liquid fuels We are ready to make those fuels today, and we will be ready, with new processes and new equipment, to make other fuels tomorrow They will be better fuels for better engines, and I hope they will contribute their share to a better world than we have ever known before.

SARAN...
For Short

A Wide Range of Consumer, Commercial, and Industrial Applications Lie Open to Polyvinylidene Chloride, a Plastics Material Whose Unusual Versatility Marks It for A Position of Ever-Increasing Importance

Courtesy Firestone Industrial Products Company

Railway coach seats covered with Saran fabric resist stains and wear

By *Charles A. Breskin*

Editor, MODERN PLASTICS

ONE OF the versatile plastics materials which made notable war contributions and now offers important peace-time opportunities is Saran This Dow Chemical Company resin known to the chemist as polyvinylidene chloride, is marketed under a number of different trade names by various processors *

The civilian manufacturer saw little of this material during the war for two reasons first, because of comparatively limited production facilities second, because of the immense popularity of Saran for screening to keep the malarial mosquito away from troops fighting in the tropics, for inner soles to protect their feet from fungus and jungle rot, and for tubing, pipe coating, and other chemical-resistant applications in vital scientific laboratories and industries

Saran compels widespread attention today because of its unusual versatility It can be used for extrusion, injection, or compression molding, and produced as monofilaments, multifilaments, film, or latex The range of products extend from fine fibers to heavy-duty extruded pipe and tubing, from small molded vials and ladles to electro-plating masks, and from colorful monofilaments for slip covers to moisture-proof wrapping films It is serving such diversified industries as footwear, petroleum, chemical and pharmaceutical, textile, and packaging In industry, it serves in such heavy-duty applications as spinning buckets, tank lining, pipe, and filter cloth In the consumer field it is to be found in furniture, millinery, shoes, and food packaging

There are many other uses in the experimental stage A lady's gown made of Saran fabric plus rayon and acetate was exhibited recently, though up until now little of this type product has come to market because it is believed that at the present stage of development the filament is too stiff This stiffness, however, presents no insurmountable obstacle to the material's use for draperies and institutional or commercial applications There are those who conjecture that the day may not be far off when a much smaller monofilament will be successfully extruded At present the smallest size for commercial application is about 4 or 5 mils (0 004 to 0 005 inch)

OUTSTANDING QUALITIES — Saran is highly resistant to chemicals, possesses great strength and brilliant color, is practically unaffected by acids, soap, salt solutions, most solvents and alkalis

Saran has an extremely low water-absorption and vapor-transmission rate—less than 0 1 percent after 24 hours at room temperature in the case of molded and extruded products, including monofilaments There is no accompanying shrinkage or elongation nor is the tenacity or extensibility of the material affected Saran also is unaffected by mildew, rot, or mold It is practically stain-proof and persistently refuses to be associated with such contaminating agents as chewing gum, lipstick, blood, ink, fruit juices, and the like

The material's strength and toughness varies considerably according to the method by which it is processed Molded, its tensile strength is from 4000 to 8000 pounds per square inch When extruded and oriented, experimental filaments of approximately one mil diameter have shown tensile strength up to 100,000 pounds per square inch though the usual filaments of from 8 to 20 mils exhibit strengths of from 30,000 to 50,000 pounds per square inch

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*Companies processing or using Saran and merchandising it under other names are National Plastic Products Company, "Saran by National", Chicopee Manufacturing Corporation, "Lumite", Firestone Industrial Products Company, "Velon", Viking Corporation, "Vikord", Concordia Gallia Corporation, "Cogon"; Elmer E Mills Corporation, "Mills Plastic"

One of the brightest characteristics of the material is its color From the original 20 standard colors offered by Dow, the number has grown until today, by combining the standards, almost any desired shade may be obtained For the past two years, efforts have been directed toward the production of pastel colors

Fading is a problem in virtually all materials, and has been met more successfully here than in most other cases The solution is due partly to the recognition by the materials manufacturer that different formulations react differently to the same pigment A pigment that may be fast in a formulation for tape is not necessarily fast in a monofilament, due to extrusion difficulties By varying the formulation according to its intended end use, color fastness can be improved For this reason the producer recommends that customers consult its experts concerning the type of material they want and the contemplated processing method on the theory that color considerations may be involved in making up the raw material As a result of this far-sighted planning, Saran colors show up very well in rating tests, wherein polyvinylidene chloride is placed alongside a standard dye of the same color and with which it is compared after weathering In this test, the ratings are from 0 (poorest) to 8 (the best) and most of the Saran colors used rate between 6 and 8

DISADVANTAGES — With all its manifold advantages, why haven't manufacturers discarded all other plastics and used Saran exclusively? First of all, there are economic considerations With colored resin or powder at around 40 cents a pound, Saran rates among the moderately priced plastics, but not among the cheapest

Also, its processing presents certain difficulties For example, because the difference between its decomposition and processing temperatures is very small, special equipment is often needed for controlling heat applications Further, only such metals or alloys as Hastalloy A, Hastalloy B, Stellite 19, nickel, z-nickel, and magnesium are recommended for use in those portions of the heating cylinder that come in contact with the material at molding temperatures This is necessary because metals normally employed in such machinery speed the heat decomposition of the plastics at temperatures above 200 degrees, Fahrenheit

Another problem attendent upon the use of polyvinylidene chloride concerns the difficulty involved in obtaining adhesion between it and other materials One user asserts that the most successful adhesives are those containing rubber Even this adhesive, however, leaves something to be desired, and all the companies working with Saran—including Dow—are still seeking the real solution

The growing use of Saran make it clear that in many fields the special virtues of the material far outweigh the disadvantages Why this is so can be gleaned from the following brief summary of major successful applications

Screening One of the greatest single outlets for the material is the war-tested application of screening Perhaps the best testimonial to its worth is a statement issued recently by the Materials Branch of the United States Army's Engineer Board which, after a thorough test of all possible materials for screening, reported

"Of the screens tested, Saran and phenolic-coated glass cloth screening were the most durable If metal screening must be used, bronze screening coated with two coats of paint is recommended"

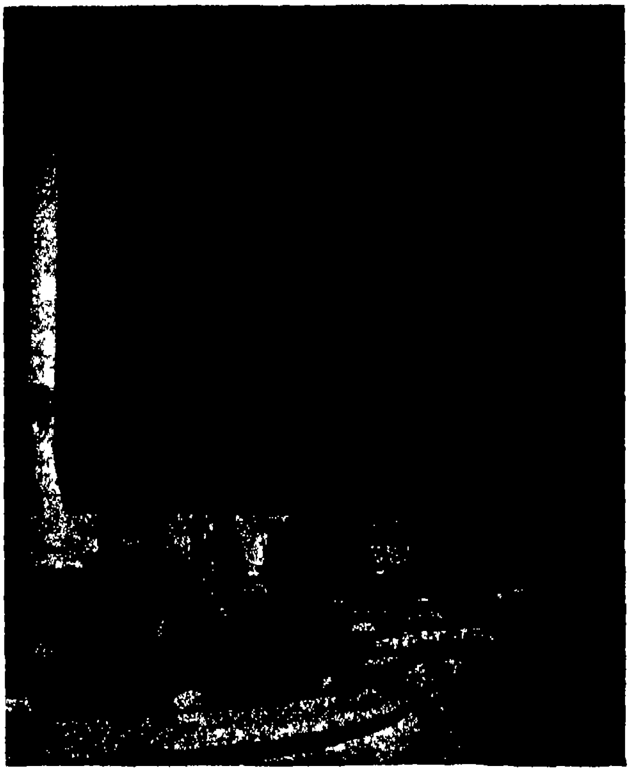
Only the Saran type of the two plastics screenings mentioned above is commercially available, and this the Army found more durable than metal when subjected to weathering, salt water, salt spray, heat, humidity, and attack by fungus Little wonder then that the quantity of Saran screening sold in the year ending June 1, 1947 is estimated by a principal producer as not less than 120,000,000 square feet Before the war, when plastics screening was not yet in evidence, the market for metal screen averaged about 500,000,000 square feet a year

Woven monofilaments Not only can Saran fabric be produced in varying weights achieved by varying the diameter of monofilaments (8, 10, 12 mil diameters being the most common) but it can be turned out in almost any type weave At present, herringbone, twill, broken twill, and honeycomb weaves are most generally employed A big advantage so far as the producer is concerned lies in the fact that any textile mill can, with only minor changes, switch from cotton, woolens, or rayon to this synthetic textile

As for the outlets for this material, auto seat covers rate high One reason for its popularity in this application is that the open weave permits breathing (in contrast to solid type upholstery), which makes the covers cooler in summer and warmer in winter

Piping and fittings of Saran are combined with metal parts in this water purification unit

Courtesy Dow Chemical Company



Then too, if properly woven for the application, this Saran material makes it easier for passengers and driver to slip in and out of the seats Seat manufacturers like this material because it can be sewed on the same heavy-duty machines used for other materials, and with the same needles Nylon thread is recommended The way in which woven polyvinylidene chloride will give under pressure, but come back immediately when the pressure is removed, is good insurance against cupping and sagging auto seats

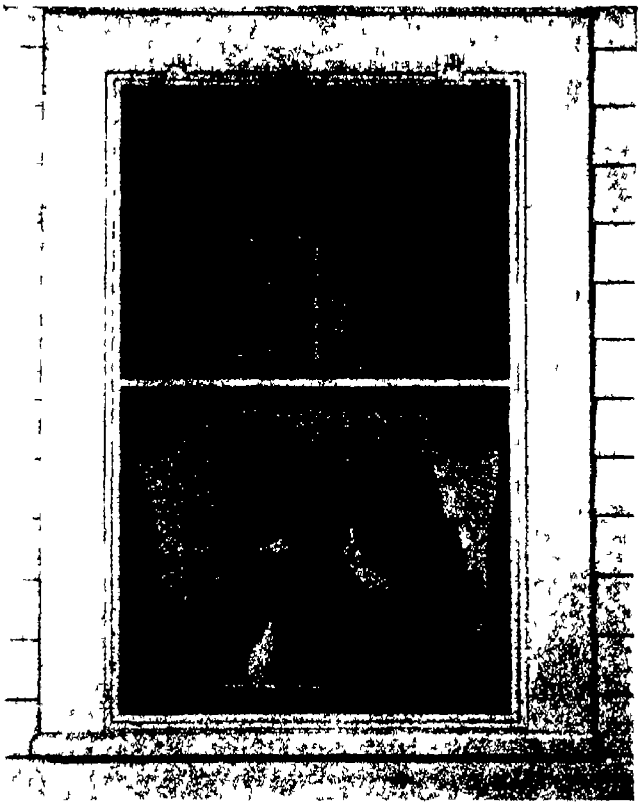
Upholstery for railroad and bus seats, office furniture, auditorium and theater seats, and for hospitals is another important outlet for the Saran woven fabric—one demanding much the same characteristics needed in auto seat covers

Saran is used in paint spray gun handles for its light weight and chemical resistance

Courtesy Dow Chemical Company

Less obvious, but even more important perhaps, is the use of woven Saran in the heavy-duty commercial field Here it is to be found in filter cloth where its commercial resistance is of importance Then there is the use of the fabric for dippers for use in recovering items from strong acids And also in conveyor belts there is an important potential application

Rope While the market for Saran rope is still somewhat of a conjecture, the material possesses a number of interesting and potentially important properties When compared with manila rope the weight of Saran rope in corresponding sizes is from 35 to 60 percent greater Exposure to weather, winter or summer, does not reduce its strength nor does alternate drying and wetting change its properties Wet strength is the same as dry strength Further Saran rope does not rot Under repeated loading it has a working stretch from three to four times greater than manila rope, making it considerably more resistant to shock loading



Courtesy Chicopee Manufacturing Corporation

Screening made of polyvinylidene chloride is durable and needs practically no maintenance

Moldings Saran can be injection or compression molded—each process imparting special advantages to the finished product For example, compression moldings have improved chemical and mechanical properties, are stronger and tougher and have increased impact and tensile strength as compared to injection moldings In addition, larger parts can be made by compression molding However, compression molding requires greater care and presents more processing problems

Examples of compression molded applications include spinning buckets and dipping baskets for textile processing Here the material's toughness, durability, rubber-like consistency, chemical resistance and resistance to water absorption stand it in good stead Dipping baskets that are generally used today are either nickel plated or made of pottery, and must be replaced frequently due to chemical corrosion or breakage Saran baskets not suffering from either failing, thus mean less frequent replacement

Other compression-molded Saran parts include rollers for textile and chemical plants, valves, pipe joints, and flat sheets for use as metal tank linings in chemical and electroplating plants

As for injection moldings, the field has only been touched However, handles for paint spray guns are a typical application which makes use of the material's chemical resistance and lightness Small spinnerette couplings, gasket holders and valve seats for water chlorinators, pipe elbows, and tubing for a spray are other injection-molded Saran parts that indicate the wide field of application for this process and this material.

CONCRETE AGAINST X-Rays

From the National Bureau of Standards

Protection of Personnel in the Vicinity of High-Voltage Industrial X-Ray Equipment Becomes a Greater Problem as Voltages Go Up and Uses of X-Rays Broaden. Studies Now Underway are Aimed at Replacing Guess-Work With Facts Which Can be Fitted to Individual Installations

EFFECTIVENESS of concrete barriers against multi-million volt X-rays, whose use is increasing in industry and medicine is the subject of an extensive program being conducted at the National Bureau of Standards. At the present time, exact wall thicknesses and most desirable types of construction necessary for maximum X-ray protection are not definitely known. One of the basic aims of the new project is to collect data from which the highest degree of protection with the lowest possible cost of installation can be calculated.

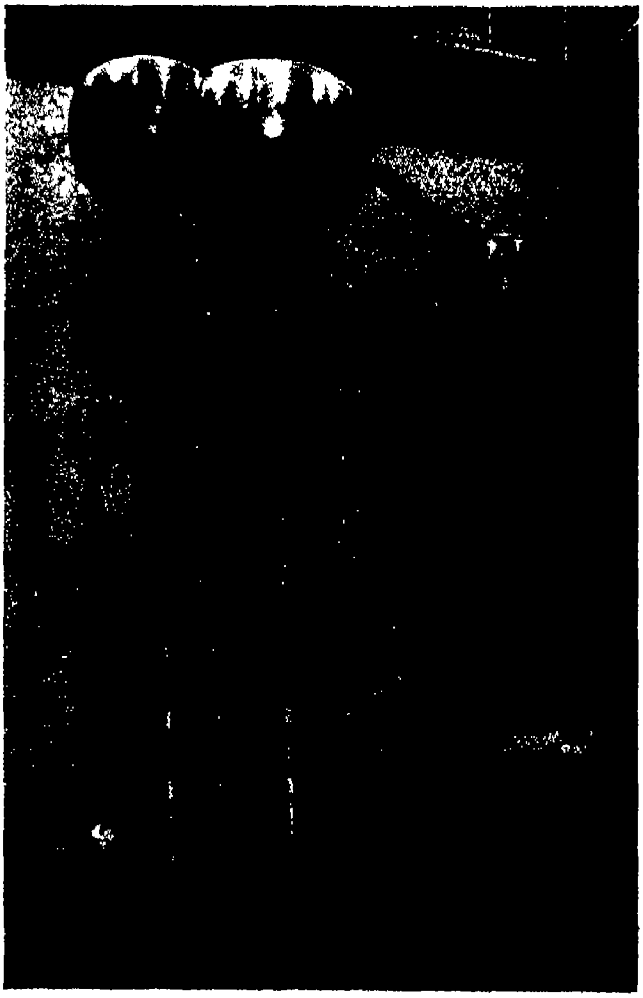
Industrial uses for million volt X-ray equipment were greatly increased during World War II when industrial engineers turned to it as a device for detecting flaws in all types of metal. In particular, broad beam X-rays, which permit simultaneous examination of wide areas, came into extensive use. While broad-beam X-rays, ranging in diameter up to four or five feet, are not essentially different (except for the amount of surface covered) from narrower-beam radiation, they pose a special protection problem.

When a broad X-ray beam enters a thick concrete wall, it is scattered and rescattered many times with the result that a considerable fraction of the beam emerges on the other side, endangering near-by personnel. Quantitative information on the amount of this scattering is not yet available.

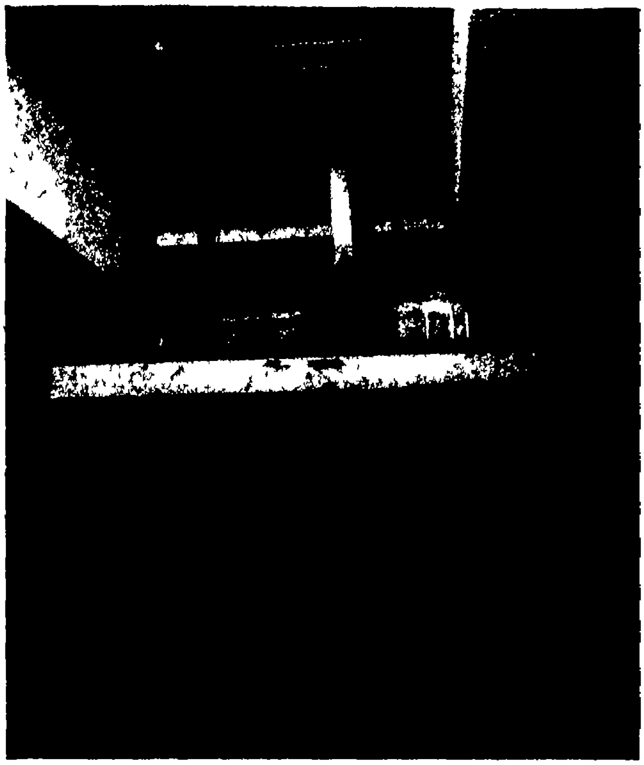
Users of million-volt equipment have been seriously concerned with this phenomena and in order to assure a wide margin of safety have constructed barrier walls of exceptional thickness. Field attempts to make measurements establishing optimum thicknesses and construction characteristics involve so many variables that it has been decided that the entire project, except for final testing, must be carried out in the laboratory, where the variables effecting radiation hazards can be simulated, controlled, and analyzed.

Industrial X-rays are used in three ways for metal examination. Radiographs are obtained by directing beams of X-rays through a metal object and recording the shadow lines on photographic plates. Many examinations of small parts are made by a fluoroscopic screen. X-ray diffraction, a relatively new technique, is a method for studying crystalline structure, where the X-rays are diffracted by the crystals within the metal and are recorded photographically or by means of a Geiger counter.

To determine protection standards, a 1,500,000



The National Bureau of Standards' X-ray generator delivers 25 milliamperes at 1,500,000 volts



To determine the protective value of concrete, slabs of accurately formulated cement mix, six inches thick and weighing 2½ tons, are placed one by one over the mouth of the radiation pit

• LOOKING AHEAD •

Safer use of industrial X-ray equipment. Reduction in installation costs. Massive concrete walls used only where needed, not indiscriminately. Concrete-lead sandwiches reducing bulk of X-ray protective barriers.

volt X-ray machine in the Bureau's laboratories has been converted so that it will produce beams of varying widths. It is mounted so that it can be directed downward into a "radiation pit" about 6 feet square and 20 feet below the target of the X-ray tube. Special instruments, designed to explore the strength of the radiation in the pit, can be shifted to various positions by remote control.

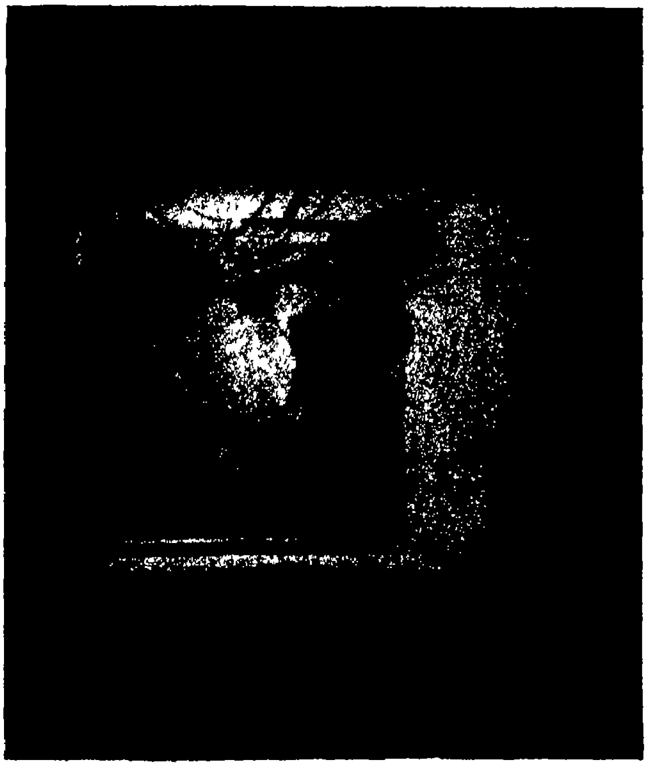
LEAD-CONCRETE SANDWICHES — During the investigations, test slabs of concrete each weighing two and one-half tons and measuring six inches in thickness are used. These slabs, when placed over the mouth of the pit one at a time, enable investigators to vary the protective barrier from six inches to five feet in thickness. Since space and weight are of critical importance in many installations, arrangements have also been made for producing sandwiches of lead and concrete in alternate layers. At present, the best proportions between these two materials are entirely unknown.

Studies of radiation hazards have been carried on continuously at the National Bureau of Standards since 1913. At that time the early type of gas-filled X-ray tube was used. Though voltages were low, long exposures may have been responsible for the many cases of serious burns on record for that period. About the time of World War I, the new high-vacuum Coolidge X-ray tube came into use, operating at higher voltages, with radiations of correspondingly greater powers of penetration. Exposure times were reduced, eliminating some of the hazard to the operator. But accompanying this was the increased penetration of the X-ray due to higher voltages and the greatly extended use of X-rays with the increased versatility of the equipment.

For equipment operating up to 200,000 volts, lead afforded the best means of protection. A room used for diagnostic purposes, for example, has to be lined with 1/16 inch of lead to prevent the escape of rays to surrounding rooms with consequent danger to the occupants. Correspondingly, in deep therapy installations, the room must be surrounded with 3/16 to ¼ inch of lead. Because ¼-inch lead weighs 16 pounds per square foot the installation of such protective shields becomes a very massive and costly project. In the early days, such protection had to be provided around the entire X-ray room, since the X-ray tubes were operated in the open and the penetrating X-rays were emitted in every direction.

One of the Bureau's first problems was to study ways and means for improving protection in the im-

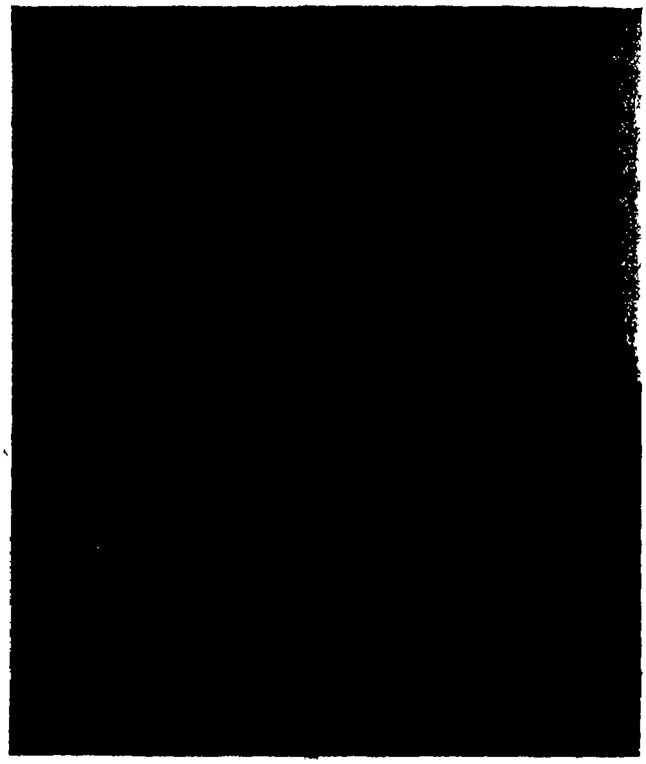
Radiation pit in which penetration measurements are made is about six feet square and is located 20 feet below the target of the X ray tube. Measuring instrument (at man's right hand) can be moved to any part of the pit by remote control



mediate vicinity of the X-ray tubes in such a way as to reduce the protection necessary in the room walls As a result of these early studies, it was found that a relatively small weight of lead could be placed closely around the X-ray tube, allowing the rays to escape only in the direction in which they would be utilized By doing this, lead protection in the remaining walls of the room could be reduced 50 to 75 percent except for that small portion of the walls or floors in the path of the main beam This meant immense savings in the initial cost of X-ray installations.

AUXILIARY PROTECTION — At about the same time, studies were undertaken to determine the efficiency of such auxiliary protective devices as lead aprons, lead rubber gloves, lead glass windows, and wall plasters made of material loaded with lead or barium Some of these devices were found to be effective while others were not For example, lead glass goggles for the protection of the eyes were found to offer little or no protection In fact, they proved to be more of a hazard than a protection because they gave the user a false sense of security

Lead glass has always been a necessary adjunct to an X-ray protective installation This is particularly true in therapy work where the operator of the machine must remain outside the treatment room and yet have a good view of the room through a window or some other device Such windows were made of glass loaded with lead Many of the glasses sold for protective purposes were found to contain so little lead as to be of negligible value Others have adequate quantities of lead but were so discolored by the addition of the metal that they are unsuitable for window purposes. Up to about 1930 practically all of these glasses were imported from Europe Under the impetus of a broad study of X-ray protective glasses by the Bureau, American industry was encouraged to undertake the development and production of such materials As a result this country now produces the finest grades of lead protective glasses obtainable anywhere in the world


All measuring and auxiliary equipment in target room is controlled from panel in a well protected room

Beginning about 1930, X-ray tubes for operation up to 400,000 volts and higher were developed and began to come into use for both industrial and medical purposes The thickness of lead necessary to shield a 400,000-volt X-ray tube adequately is of the order of ⅝ inch in thickness It is obvious that the weight and cost of such a room assumed prohibitive proportions Massive walls of concrete were suggested as a substitute for lead While these had the advantage of being part of the building structure concrete nevertheless introduced serious engineering problems because of its weight.

It was not until the Bureau undertook a comprehensive study of concrete for protection that the economics of such protection could be reduced to a reasonable scale Prior to this, concrete walls were simply installed by guess methods As a result of studies, it was possible to decrease the requisite wall thickness substantially and still maintain a high level of safety

BEAM DIRECTION RESTRICTED — By the time X-ray voltages had gone up to one million and two million volts, the protection problem again became critical Studies were undertaken along the same line as for 400,000 volts, and it was determined that in most cases all secondary X-rays could be satisfactorily stopped by an ordinary reinforced concrete wall, varying in thickness from 8 to 12 inches To cut off the direct beam would require from 12 to 18 inches of concrete, but it was usually possible to minimize this extra thickness of protective concrete by restricting the direction of the beam

With the advent of the betatron operating at from 50 million to 300 million volts, scientists are confronted with a new series of X-ray problems While protection from the direct beam of X-rays at 50 million volts is very important, there are other simplifying factors in the problem For example, as higher and higher voltages are used in the production of X-rays, the rays themselves tend more and more to emerge in a single direction from the target Thus the X-ray beam from a 50 million volt betatron covers an angle of only six or eight degrees For protection from this beam alone, very great thicknesses of concrete may be required On the other hand, X-rays which are scattered sideways out of this beam are of low penetrating character, and as a consequence it may be found that the protection problem to the side of the beam may not be seriously different from that at one or two million volts.

The exact answers to these important problems, however, are uncertain at the present time and it is the responsibility of the National Bureau of Standards to set up the necessary experimental arrangements to properly evaluate them. Again, solutions must be found which are safe and yet provide the maximum economy, since the cost of protection alone in a 50 million-volt installation may represent half to three quarters of the total cost

SCIENTIFIC AMERICAN'S
Industrial Digest

VISCOSIMETER

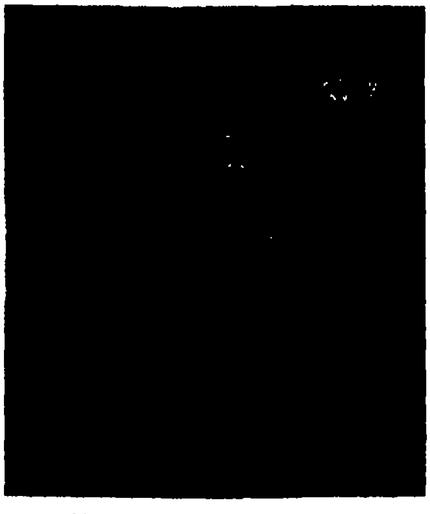
Assures Proper Thickness of Spraying Enamel

THE VISCOSITY of the enamel sprayed on metal shipping containers manufactured by the Cleveland Steel Barrel Company is now accurately controlled by the use of the General Electric Company's Zahn viscosimeter This instrument is designed to simplify the otherwise difficult task of making viscosity measurements

Until the Cleveland company began to regulate the viscosity of their enamels with the viscosimeter, the containers often came from the drying oven still sticky because the enamel sprayed on them was too thick to dry properly In other instances, it was found that the coating was too thin, thus necessitating respraying many of the containers Consequently, the efficiency of this operation was decreased

Now the previous trial-and-error method of thinning enamels to the proper consistency for satisfactory spraying is no longer relied on Instead, use of the viscosimeter has resulted in the establishment of a set of standard viscosities for various types of enamel, regardless of color In addition, the instrument is also used to facilitate determining the correct quantities of thinner and dryer to be added to the enamels in order to obtain a durable and attractive baked finish

This company uses approximately 5000 gallons of paint and enamel monthly for spraying about 200,000 of these resistance welded steel containers, which range from 2½ to 65 gallons in capacity



Measuring enamel's viscosity

RIGID TESTING MACHINE

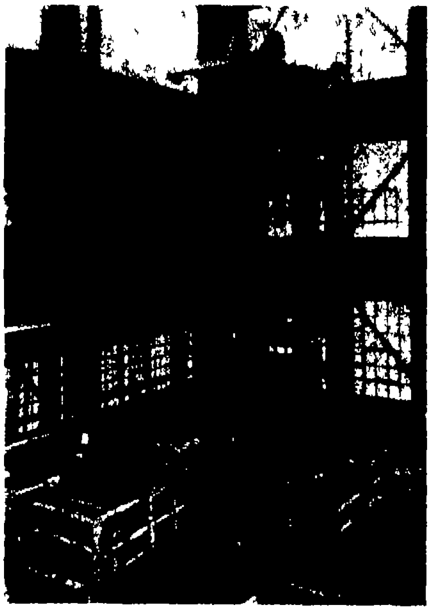
Exerts 2,000,000 Pounds For Tension, Compression, or Transverse Tests

ENTIRELY new construction principles are embodied in the University of Washington's new 2,000,000-pound testing machine, designed and built by The Baldwin Locomotive Works

According to Professor F B Farquharson, in charge of the University's testing research, the machine, while not the largest in use by industry, incorporates several new features in design which make its steel columns more rigid than has heretofore been possible, give the machine greater accuracy, and make it more versatile

Special flex-plate construction ties the sensitive yoke to the transverse rigid beam Another feature involves adjustable guides, made triangular in shape, making it possible not only to keep horizontal movement to a minimum but also to lock the crosshead in position when required

A third feature, which makes it possible to maintain the minimum tolerance against horizontal deflections under load, to prevent premature buckling of compression specimens, and to neutralize horizontal components of force, is the flaring of the steel columns from a point about one third of the way from the top to the base of the machine This affords maximum rigidity or minimum deflection when testing specimens so long that their height forces the columns to function as cantilever beams It is asserted the machine will have from 300 to 400 percent greater rigidity than machines of earlier design



Versatile testing machine as it appeared with scaffold during erection

The University plans to devote the machine to special testing research on materials for Boeing, including aircraft wing panels, to various tests for the timber industry, to testing concrete culverts for the state highway department, and to other work for industries of the Northwest, according to Professor Farquharson

The machine is to be used for tension and compression testing, as well as transverse testing It will take specimens up to 10 feet wide, 20 feet high, and (for transverse testing) 80 feet long Its versatility is shown by the fact that it will enable the research man to test materials for all six forces and six moments

ELECTRONIC MICROMETER

Highly Sensitive, Gives Readings On Oscilloscope or Meter

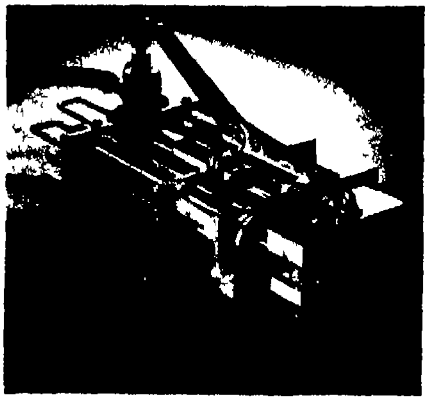
AN ELECTRONIC micrometer used to measure the displacement of a six-inch turbine shaft in its journal is so sensitive that a deflection of 0 01 inch of the center of the shaft provides a two-inch movement of the center spot on a cathode-ray tube Readings to 0 001 inch are easily obtained, and the indication on a meter is linear to within a fraction of 1 percent

Developed by M L Greenough of the National Bureau of Standards, the instrument was primarily designed to afford a means for measuring thickness of the oil film in the bearings of a large Navy turbine shaft

In operation, radio-frequency current is applied to a radiating coil, when the unit is held at some distance from a metallic object, the field from the radiating coil induces voltage in the pickup coil, which is measured on either an oscilloscope or a meter —*K.H*

SEALING PLASTICS BOXES

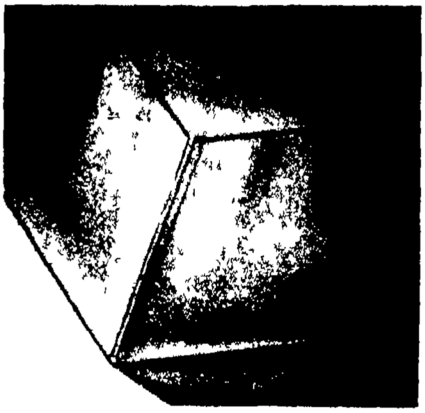
With High-Frequency Generator Reduces Waste



Heater, clamping overlapping box corners, seals them in a quarter second

A NEW APPLICATION of electronic sealing to transparent box manufacture, which promises, among other things, to speed up production, was developed by the Eastman Kodak Company This method is expected also to reduce waste, improve box appearance, lead to greater uniformity of product, and eliminate the distortion sometimes caused by the cementing operation usually employed in transparent box manufacture It is applicable to acetate sheet with thicknesses of 005 inch and heavier

No cement is used in sealing transparent boxes with this method The technique consists merely of firmly clamping overlapping portions of the box ends and sides between two electrodes of the heater The "deep-heat" thus produced fuses the two pieces of acetate in as little as one quarter of a second In spite of the high temperature developed within the acetate sheet, the outer surfaces remain cool, and the electrodes never heat up Box seams produced by this method are only 1/16-inch wide and almost invisible Large "ears" are unnecessary on box blanks since the seams practically coincide with the corner crease



Box corner sealed without cement

Many of the standard high-frequency generators now on the market can be used to produce the power required for this purpose Interchangeable electrodes or sealing heads to accommodate boxes of various sizes may be made in any machine shop

DYEING GLASS YARN

With Ordinary Dyes Possible if Fibres First Have Gelatin Coat

DEVELOPMENT of a new process of filament coating, whereby a thin protein film (gelatin-type) is applied to Fiberglas yarns as they are formed, has made it possible to dye the yarns with ordinary dyes and by commonly used methods The protein film represents only 1 to 2 percent, by weight, of the finished yarn, but with this small amount of film, improved depth of color has been achieved, due to absorption of the dyes by the film on the large surface area presented by the multiple-filament yarn

ELECTROLESS PLATING

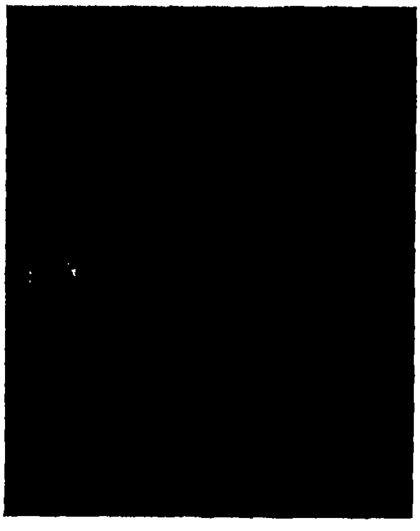
Of Nickel, Cobalt on Metals by Chemical Reduction

PLATING nickel and cobalt on metal surfaces without the use of electric current, a new process known as electroless plating, is brought about by chemical reduction of a nickel or cobalt salt with hypophosphite in hot solution The reaction is catalytic, and under the prescribed conditions of concentration and pH, no plating occurs unless certain metals, such as steel or nickel, are introduced in the bath The reduction then occurs only on the surface of the immersed metal with the production of an adherent coating of 93 to 97 percent purity

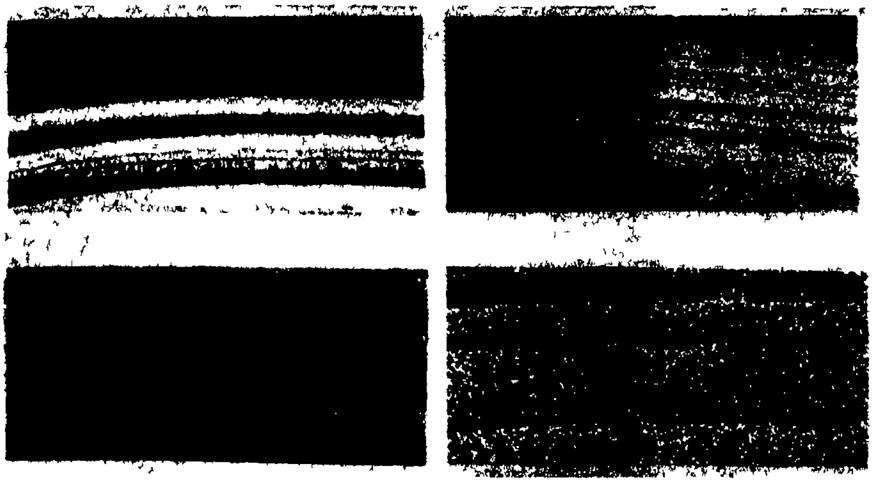
Photomicrographs of deposits obtained in this way show both a laminar and a columnar structure similar to bright nickel electrodeposits The electroless deposits are of good quality—sound though brittle—and unusually bright Since they can be made as hard as tool steel, the method may prove useful where hard, wear-resistant surfaces are required, as in bearings The process is particularly applicable to plating recesses, irregular-shaped objects, and enclosed areas such as tubes, where a centered internal electrode with special current leads would be needed in electroplating

The equipment is simple and more easily assembled than that required for electroplating No generators, rheostats, special racks, or contacts are necessary Small parts which cannot be barrel-plated economically are readily plated by the electroless process if suspended by a string or in a bag affording ample exposure of the metal surface to the solution There is no need of constant motion, as in barrel plating, since current distribution is not involved The reactions require a temperature above 90 degrees, Centigrade

A unique feature of the electroless process, developed by the National Bureau of Standards, is the catalytic initiation of the reaction by the following metals Iron or steel, nickel, gold, cobalt, palladium, and aluminum Unless one of these metals is introduced into the solution, no reaction takes place Once started, the



Equipment for electroless plating includes only vessel, solution, and immersion heater (projecting from bath)



Photomicrographs of electroless nickel deposits. Upper left: Nickel as deposited. Upper right: After annealing at 400 degrees, Centigrade, for 30 minutes for maximum hardness. Lower left: After annealing for 30 minutes at 600 degrees, showing precipitation. Lower right: After annealing for 30 minutes at 800 degrees, showing excessive precipitation.

reaction continues at the metallic surface, and only rarely occurs in other parts of the bath. For this reason, the containing vessel should be of glass, plastics, or other non-catalytic material.

Electroless plating on non-catalytic metal surfaces may be accomplished in two ways. If a film of palladium or rhodium of nearly monatomic thickness is first applied by chemical replacement on a non-catalytic metal, deposition of nickel or cobalt will occur on the activated surface. Electroless plating of copper may be carried out in this way. A second method of initiating the reduction is to bring a less noble metal, such as iron or aluminum, in contact with the non-catalytic metal while it is immersed in the hot electroless solution. Once the process has been started, it continues because of the catalytic action of the initial deposit.

ELECTRONIC SOLDERING

Applied on Production Basis To Increase Output

A SIGNIFICANT practical application of high-frequency induction heating to the soldering of conductors to end rings in small squirrel-cage motors rotors has been accomplished by an Illinois manufacturer. The rotors are ¾ inch in length and one inch in diameter. The process is continuous with a production rate of 600 per hour.

Using the former conventional process, consisting of jigging the assembly and then dipping each end into molten solder, production rates in the neighborhood of only 150 per hour were obtained. In addition, the hot dip method is cumbersome, wasteful of solder, and somewhat messy. In the new process, the end rings are tinned with solder prior to assembly, the assembled rotors are rolled down an inclined track and through an electromagnetic field established by a work coil. The currents induced in the ends of the rotors melt the solder and "sweat" the conductors on to the end rings.

The high frequency power equipment is an RCA two kilowatt electronic power generator, which converts the 60-cycle power supply to a frequency of about 400,000 cycles. Not only has production been increased, but results are more uniform and costs have declined in proportion to the increase in output. —*F P P*

FIRE HAZARD REDUCED

By Drawing Off Dangerous Charges of Static Electricity

ELIMINATION of a fire hazard common to many coating operations has been accomplished at the plant of the Pantasote Company in a simple and effective way. In this operation static electricity is a constant and dangerous problem, as the product moves through the machines, for a spark can ignite vapors of the volatile solvents used.

Static charges in this plant are now safely drawn off by application of an Ionotron static eliminator [See also Scientific American, July 1946, page 30.—*Ed.*] This device consists of a shielded bar supporting a strip of radioactive alloy at the point on the machine where the static charges tend to build up. The air at this point is ionized by the alpha rays from the radioactive source, and acts as a conductor to draw off the charges as they are generated.

The Ionotron, a product of the

Radioactive strip (arrow) locally ionizes air, providing a path of escape for static charges as they build up, eliminating possibility of sparks

United States Radium Corporation, is said to be the only type of static eliminator suitable for this application, as it involves no electrical power source or other possible ignition danger, and is not in physical contact with the coated surface.

SYNTHETIC QUARTZ

Grown in Silica-Sodium Solution For Electronic, Optical Uses

QUARTZ crystals, required in optical and electronic devices, and hitherto available only from scattered natural deposits, will be produced by the Naval Research Laboratories, Washington, D. C., as soon as equipment is installed for the operation of a new process of growing them. The method is based on techniques developed in Germany, and depends on the growth of a crystal from a seed placed in a solution of silica, sodium hydroxide or carbonate, and water, heated to 350 to 400 degrees, Centigrade, in a steel bomb. Pressures generated may reach 2000 to 3000 pounds per square inch. The new method is reported to yield crystals satisfactory for present known uses, and is expected to make the United States independent of the foreign sources from which these essential crystals hitherto have come.—*D. H. K.*

TURNBUCKLES TAPPED

In Specially Designed Multiple Tapping Head

TAPPING 2¼ inch deep un-drilled holes in cold rolled turnbuckles at a speed of 12,000 pieces per machine per 24-hour day is one way in which one manufacturer is meeting a demand for greatly stepped-up production without any increase in operator effort.

The particular job involves tapping a hole 2¼ inches deep in each end of a turnbuckle for automotive tie rods. The turnbuckle is formed by rolling 0.125 inch flat stock. The edges of the finished part are left open. Thus the inside diameter which is to be tapped is neither a machined surface nor a drilled hole. Due to the method of making the turnbuckle, rather generous tolerances are allowed, the inside diameter being held to .626-.633 inch and the outside diameter to .870-.880 inch.

A specially designed multiple tapping head accommodating four taps and fixtures which permit fast manual loading, automatic clamping, and automatic unloading at the end of the tapping cycle is used. Taps made of a special chrome-cobalt high-speed steel, developed by the Detroit Tap and Tool Company, were adopted as standard on the basis of production records. The manufacturer of the turnbuckle, the Thompson Products Company, reports that these taps turned out 500 finish tapped turnbuckles before regrinding became necessary, as against 175 for the average straight high-speed steel tap. The M-11 taps, as they are called, also permitted a total of eight re-grinds before the tool had to be scrapped, instead of six re-grinds averaged by other tools.

The four tapping heads turn out 12,000 threaded turnbuckles per 24-hour day

Turnbuckle (left) and tap (right)

DISTORTION OF METAL

In Arc-Weld Build-Up Can Be Minimized, Say Engineers

THE PROBLEM of distortion in metal, frequently met when building up worn surfaces with arc welding where the amount of weld metal to be deposited is large in proportion to the parent metal, can be minimized if certain precautions are taken, according to welding engineers of General Electric.

If the surface to be built up is not already worn smooth, it should be ground smooth. Pre-heating to unlock stresses is helpful, if permissible. Electrode size should be small, and the current kept in the mid-range to prevent excessive heating.

Beads should be kept thin and should be well peened. Only small areas should be covered between peenings. Alternate layers should be laid at right angles. Plenty of pressure on the wire brush between welds will aid sound metal build-up.

CARD TABLE TOP

Molded From Phenolic, Is Stronger, Costs Less

MOLDED in one piece of general-purpose phenolic, all plastics card table tops weighing from 10 to 12 pounds are believed to be the largest-area parts thus far developed in the American plastics industry.

The phenolic tops, molded by the Goodchild Plastics Company, are credited not only with being as light as other tops of comparable size and strength, but also with being stronger than tops constructed from laminations of wood or paper. More important, perhaps, is the fact that these plastics tops cost 17 to 21 percent less than a comparable quality part made from other materials, and that they have no dust-collecting joints or seams, no corner laps, wrinkles, or folds.

These tops, for which Durez, Bakelite, and Makalot general-purpose phenolic compounds are used, have a uniform finished thickness of a quarter inch. For greater rigidity, the tops are reinforced by 1¾ inch sides, ¼ inch thick, and by six ribs, ⅞ inch high, arranged in waffle design and molded into the under side. Also molded into the under side, adjacent to the inside faces of the outer ribs, are four leg attachment anchors.—*C. A. B.*

SPINDLE LOCK SYSTEMS

Prevent Motors From Starting Till Locks Are Released

LOCKING machine spindles so that tools or work may be changed without damage to bearings, or without the need to hold the spindles with wrenches, is an ancient trick of the machinist. And in the old days when the starting of a machine with its spindle locked meant only the squealing of a slipping belt, these locks were fairly proof against carelessness.

With electrically motorized machines, however, it is a different story. With several motors there are several possible sources of delay or damage. Locks therefore are being so placed that it is impossible to start a motor unless all of the spindles have been released.—*E.L.C.*

New Products

HEAVY-DUTY CLEANER

Vacuums, Blows, Dries, And Sprays

Blowing air at a velocity of 25,500 feet per minute, a new heavy-duty industrial cleaner is powered with a 1 1/3 horsepower motor and weighs only 14½ pounds It has precision-type sealed ball bearings and air stream cooling scrolls which permit continuous operation without overheating It is claimed that the blower is able to run continuously for 24 hours a day, if necessary

This new cleaner, manufactured by Ideal Industries, Inc , serves a multitude of industrial and commercial uses It vacuums, blows, sprays, and dries, and is quickly and easily converted to any of its functions

With powerful suction force, it cleans away dirt, dust, and grime which accumulates on and around machinery, motors, generators, and so on

In some instances, where the parts to be cleaned are encased or otherwise inaccessible, such as in air conditioning, refrigeration, and heating units, the dirt to be removed has become oil-soaked and heavy, and must be blown out The blower does the job easily and safely While blowing velocity is high, the pressure is low, eliminating the possibility of damage from blasting

The unit may also be used as a sprayer for deodorants, insecticides, paint, varnish, and so on And if drying action is desired, a heater nozzle is attached to the blower, which raises the temperature of the blown air to a minimum of 85 degrees, Fahrenheit This is useful in drying motor windings and electrical equipment, and also for drying paints, inks, and so on

In addition to this heavy-duty blower, there is also available a medium-duty model with a 2/3 horsepower motor, which displaces air at 19,000 feet per minute This model weighs 9½ pounds

STUD WELDING

Results in New Blind-Fastening Method of High Strength

Three out of every ten cars coming off the 1947 automobile production lines are minus the bolt heads that have always marred the streamlined surfaces of bumpers The secret of this construction lies in the fact that leading motor manufacturers are now attaching bumpers to their frames by the new blind-fastening method of stud welding

Bolt holes, which reduce the basic strength of these parts and provide an inevitable starting place for corrosion, are eliminated by the use of stud welding in which headless bolts are welded directly to the interior surface of the parts

DYNAMOMETER SCALE

Eliminates Double Handling by Weighing At Stock Pile

Saving considerable time and labor while taking inventories, a portable dynamometer scale eliminates the necessity of moving stocks to a platform scale, usually some distance from the stock piles, and then moving them back again The scale which does away with this double handling fits the crane or hoist hook and reads instaneously in pounds on the face of the dial With this scale, made by W C Dillon and Company, on the hook the load can be lifted right at the stock pile and immediately replaced without further handling Dillon dynamometer scale capacities are from 0 to 500 pounds to 0 to 20,000 pounds Scales are all the same size and same weight regardless of capacity

Scale is between load and hoist hook

RUBBER-BASE PAINT

Resists Moisture and Abrasion, Gives Long Lasting Protection

Forming a tough, hard, elastic coating which is highly moisture-proof and resistant to acids, alkalis, and abrasion, a rubber-base paint may be used on wood, metal, plaster, cement, and many other surfaces

The coat is smooth and velvety to the touch, with a high gloss, and may be applied by brush or spray A product of Foundry Rubber, Inc , the paint

Spraying, blowing, and vacuuming with same basic blower unit

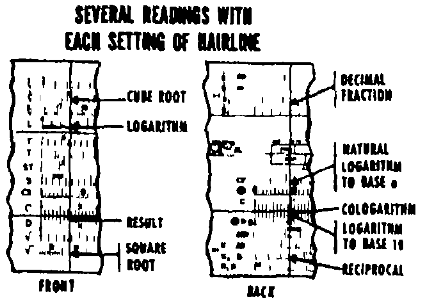
dries sufficiently in 10 or 15 minutes to receive a second coat, and in four to eight hours, depending on temperature and humidity, it is fully hard and dry

Particularly well suited to use in foundries for the protection of wood patterns subjected to severe ramming of hot moist sand, this paint, called Paracoat, is said to resist sand abrasion and outlast shellac, lacquer, and other finishes by four to eight or more times Foundries report that Paracoat does not become tacky or sticky as shellac does, and the patterns draw clean and clear of sand Also, the moisture-proofing qualities of the paint stabilize the moisture content of the wood, thus eliminating warping

SCHOLASTIC SLIDE RULE

Has New Slide Arrangement To Simplify Computations

With scales on the front of the rule so arranged that only one setting of the hairline gives with each result its square root, cube root, and logarithm, a new deci log log slide rule, greatly simplifies computations The log log scale on the back is expanded for greater accuracy, and arranged to give these five readings with each setting of the hairline 1) decimal fraction to four and five figures, 2) its reciprocal to four and five figures, 3) logarithm, 4) cologarithm, and 5) natural logarithm to base The scales read from one ten billionth to ten billion, and give decimal point location A simple legend tells which scale to read when raising to powers The slide rule, produced by Pickett and Eckel, Inc, is made of magnesium alloy with a plastics surface bearing permanent, expanded, easy-to-read washable scales The size is 12⅛ by 2⅛ by 3/16 inches



Detail of students' slide rule

VISE WITH FINGERS

Grips Difficult Shapes Surely Without Marring Work

Grasping firmly regular as well as irregular shapes which could not be held in conventional vises, a new bench vise has fingers which give the user the advantage of having a third hand This novel vise, made of solid bronze, will hold disks, rings, spheres, hemispheres, tubes, and almost any irregular shape without marring, denting, or scratching the work The vise, called Bench King, will hold work from 0 001 inch thick to two and one half inches thick with equal strength and positional convenience The four fingers supplied as accessories with the vise fit into sockets in the two jaws The vise, made by Benjamin Uydess and Sons, Inc, may be used with these fingers, with tube and ring arbors (also supplied with the vise), or it may be used alone for holding flat work

Vise fingers hold disk firmly

Vise in use without accessories

SMALL FLUORESCENT LAMP

Is Cool, High Intensity Light Source for Close Work

Designed for use on standard or special-purpose machines or for close bench work, a miniature fluorescent lamp produces a light intensity of 550 foot-candles at three inches working distance, and a color temperature of 3500 degrees Kelvin This intense illumination, converging on the subject from widely divergent angles, floodlights the subject, thereby minimizing objectional bright spots and reflections.

A normal operating temperature of 115 degrees, Fahrenheit, allows close work without appreciable radiant heat or hot surfaces The lamp, a product of Stocker and Yale, is designed for use on 115 volts, 60 cycle A C Starting is accomplished by twisting the starter knob on the lamp after the plug-in-type ballast reactor is plugged into a standard electrical outlet

Twin four-watt bulbs of standard manufacture are rated at 2500 hours normal life, and may be obtained at any electrical supply store

The lamp is finished with a baked black wrinkle exterior and a baked white enamel reflector Although normally supplied with supporting bracket and cast base, it may be obtained less these supports where direct attachment to machines is desired

Standard four-watt tubes are used

MAGNETIC PROBE

Extends, Retracts Magnet To Vary Field Strength

Comprising a powerful permanent magnet housed in a plastics tube, a new magnetic probe finds many applications in industry and in the shop The magnetic bar can be extended from the housing or retracted by turning a plastics knob at one end, by doing this, the probe's magnetic field strength may be varied—the greatest strength being reached when the magnet is fully extended Called Magicbar by its manufacturer, Eljay Enterprises, the probe resembles a fountain pen, and can be carried by means of a pocket clip

The probe is well suited to such uses as removing magnetic particles from the operating areas of machines, picking up hard-to-grasp articles such as small screws, tacks, and so on, and removing small sharp magnetic objects from storage bins Plant first-aid stations should find the probe helpful in removing steel splinters The adjustable magnetic strength feature makes it possible for the doctor or nurse to properly orient the splinter for extraction without painful rupture of the tissues

Pocket-size probe with magnet extended

POWER-FACTOR CAPACITOR

With Glass Bushings Will Not Puncture With Overload

Using cast glass bushings made of exceptionally stable low-expansion glass in which are cast metal inserts of a special nickel-steel alloy, new power-factor capacitors are hermetically sealed units The thermal expansion characteristics of the alloy are coordinated

Glass bushings at final inspection

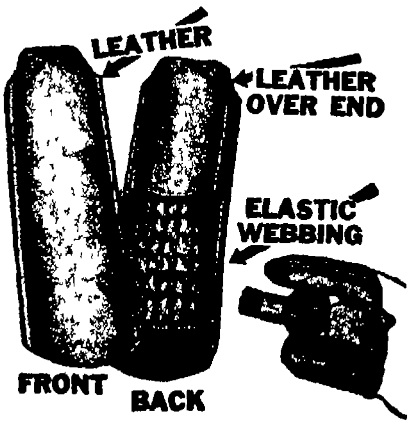
with those of the glass. A metal mounting flange cap is fused directly to the glass and the flange is in turn welded and soldered to the capacitor case, forming a hermetic seal that is permanently moisture-tight.

According to the manufacturer, the General Electric Company, these glass bushings are practically unaffected by weathering, micro-organisms, and thermal shock. When excess potential is applied, the bushings will flash over externally rather than puncture or shatter. The bushings are equipped with a split-type solderless connector, assembled after completion of the capacitor.

FINGER GUARD

Without Seam on Wearing Surface, Offers Over-End Protection

PROTECTING the thumb and fingers not only on the face and sides, new finger guards extend the leather protection over the ends of the fingers. There are no seams or joints at the finger tips, affording comfortable handling of even the smallest parts during buffing, grinding, polishing, and similar operations. The seams on the sides are well out of the wearing zone, the elastic webbing assures comfortable wearing without annoying slipping. These new finger guards are made by the Industrial Gloves Company in three weights of leather light, medium, and heavy. Four sizes are available small, medium, and large for the fingers, and one thumb size.



Guards are comfortable, will not slip

CLOTH PANEL INSTALLATION

By Locking Fabric With Plastics Strip Saves Time, Labor

FABRIC for the cloth-paneled interior of the Boeing "Stratocruiser" need no longer be hemmed or cut to exact shape. A new method of installation uses strips of Tennessee Eastman Corporation's Tenite to lock the fabric in place. One plastics strip is fastened to the airplane structure, a locking strip, about which the fabric to be installed is wrapped, snaps into place over the first strip, automatically tightening the fabric panel.

Locking strips hold fabric tightly

ELECTRONIC SORTER

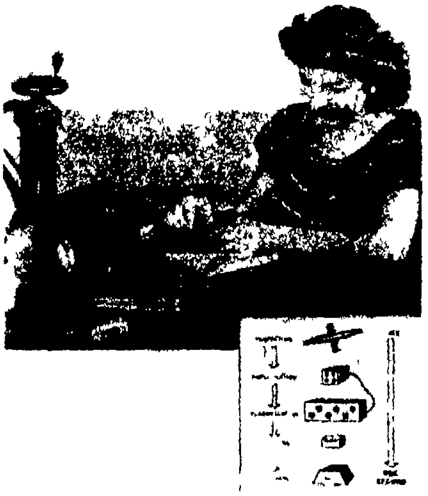
Inspects, Classifies, Counts at Rate of One Per Second

INSPECTING for accuracy of both diameter and length, an automatic sorting gage can check up to 3600 plastics fountain barrels per hour. An electronic system is used to make the actual measurements and to control the mechanical devices which sort the barrels. The device, which sorts acceptable barrels into four size catagories, rejecting over- and under-sized pieces, was made for the Esterbrook Pen Company by the Federal Products Corporation.

As the pen barrels pass through the gage, they are inspected in the following sequence

1 Acceptance or rejection for length. Over- and under-size parts fall into a reject tote box. Satisfactory parts continue through the gage.

2 Acceptance or rejection for diameter. Unsatisfactory parts fall into another reject box.



Sorting device and time cycle

3 Satisfactory parts sorted into four usable diameter groups, each tolerance equaling 0.001 inch.

Both rejects and acceptable parts are counted.

Greater accuracy, simultaneous control of two dimensions, and greater speed of work handling and inspection are counted among the advantages of this system over manual inspection methods. Labor savings alone, it is estimated, will pay for the gage in little more than a year.

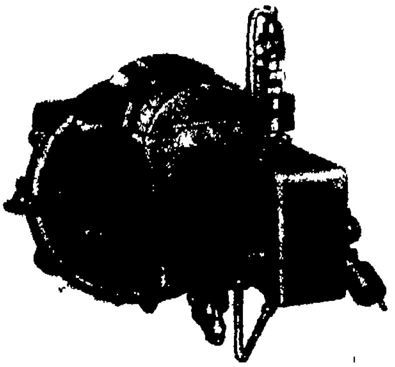
The Federal-Foote, Pierson Electronic Comparator, upon which this gage is based, is adaptable to a great many such inspection applications. Already similar devices are in use for the inspection of such articles as piston pins, bearing balls and rollers.

STABILIZED FEED BURNERS

Deliver Constant Amount of Fuel In Spite of Viscosity Changes

IN A NEW series of industrial heavy fuel oil burners, means are used to stabilize the feeding rate of fuel, regardless of changes in fuel oil temperature or viscosity. These new Iron Fireman burners have capacities from 8 to 125 gallons per hour.

Even though the fluidity of the fuel may vary widely with changes in temperature, it is claimed that these Iron



Capacities—8 to 125 gallons per hour

Firemen burners will deliver the same quantity of oil, no matter how thick or thin, and will feed evenly whether at the maximum burning rate or throttled down to low capacity It is reported that no regulating valve or viscosity compensating device is required

RADIATION DETECTOR

For Use in Field or Laboratory Is Light and Portable

BATTERY powered to adapt it for field survey work, a new and compact Geiger counter is suitable also for use in the laboratory or plant for radioactivity determinations It is carried by hand or by means of a shoulder strap when employed in such work

Detector unit weighs 17 pounds

The Geiger tube is enclosed in a housing which permits differential detection of hard and soft radiation components and is connected by a flexible cord to the internal circuits It may be employed either within the cabinet, where it is mounted in clips, or it can be removed for hand use in scanning areas where radioactivity is to be investigated

Controls and indicators are conveniently located on a top panel so that adjustments and measurements can be made while the unit is being carried For laboratory work, the counter, produced by North American Philips Company, Inc, may be mounted so that the instrument panel is in a vertical position, which facilitates observation of the radiation indicators from a distance

The indicating meter shows the rate at which radioactive pulses are received and also is used to determine the potential applied to the Geiger-counter tube Visual indication of the pulse rate is provided by the flasher which is mounted on the panel. If head phones are connected to the jack terminals, audible signals can be received

Geiger-counter voltage is adjusted by means of a convenient rotary control High- and low-voltage supplies are controlled by a master switch which is interlocked with the cover This shuts off the power automatically when the instrument is closed All components are mounted in a metal cabinet measuring 12¼ by 11¾ by 4¼ inches The instrument complete with batteries weighs 17 pounds

ASBESTOS-COTTON TOWEL

Has Good Water Absorption and Polishing Properties

SAID TO wipe dishes faster and dryer than conventional towels, a new dish towel contains 20 percent asbestos, a material long noted for its ability to resist fire, and recently discovered to have excellent water absorption and polishing properties The towel, known as Carosel, is produced by the textile division of United States Rubber Company, and is made in a range of six colors—red, green, yellow, rose, blue, and burgundy The ability of asbestos to soak up water and impart a polish to china and glass was discovered by textile engineers testing asbestos fabric for fireproof ironing board covers Asbestos combined with 80 percent cotton produces a fabric similar to linen in appearance When dyed the cotton absorbs color but the asbestos remains white, resulting in a mottled fabric While the asbestos content is sufficient to provide maximum polishing and wiping efficiency, it is not sufficient to make the fabric fireproof

NUMBERING TOOL

Built Especially For Heavy Work

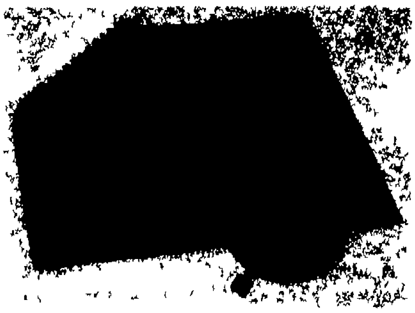
PERMITTING unusually heavy stamping, a simplified numbering machine features solid wheels and a one-piece solid bar stock alloy tool-steel holder The machine numbers from one to 999 The wheel locking is accomplished by a solid lock that fits into a depression between the characters, or separate locks for each wheel may be constructed. The numbering machine, a product of the Acromark Company, is especially well suited to field work, where it eliminates the necessity of carrying easily lost individual numbering stamps.

From one to 999

FLOOR MAT

With Rubber Cone Construction Reduces Workers' Fatigue

PROMOTING safety and comfort in factory and office, a rubber floor mat, 21¼ inches square, is made with some 2000 rubber cones, a quarter inch in height, on its upper and lower surfaces This black, non-skidding, non-marking mat not only cushions the feet of those who must work standing for long periods of time, but also protects them from possible electrical shocks An interesting feature of the mat, called Magic Mat by its producer, Avenue Manufacturing and Sales Company, is the method by which it is cleaned The mat is simply dropped onto a hard floor, and, due to the rubber-cone construction, the dirt just falls off



Magnified section shows rubber cones

WATER-SHEDDING LIQUID

Dries Metal Surfaces and Helps Inhibit Rust

HAVING VERY high penetrating power to enable it to displace water from blind holes and crevices, a new product in the form of a thin mobile liquid sheds water from the surfaces of metals After the water has been displaced, the work is removed from the liquid and the solvent evaporates, leaving a water-free surface with some rust-inhibiting properties

The liquid is recommended for drying of plated work to prevent staining, spots that normally remain on the work from solids dissolved in the water, such as chromic acid, or from the normal solids present in hard water, are removed. The water separates to the bottom of the liquid and can be drawn off periodically

The liquid, known as Hydrex, is being used for drying of jewelry which contain many recesses that formerly required alcohol, distilled water, or sawdust drying Silver plated work is being dried without spotting, using this water displacing liquid followed by a vapor degreaser This liquid, manufactured by Enthone, Inc., can be used for drying of steel after pickling and is particularly valuable for drying in the presence of high humidity when rusting occurs The liquid displaces the water from the surface of the steel and the thin film of material remaining acts as a rust-inhibitor without detracting from the appearance of the work

SAW FILER

Clamps Onto Hand Saw, Insures Proper Filing Angle

Enabling even the most inexperienced hand to sharpen a hand saw swiftly and correctly, a new tool clamps onto the saw to guide the operation Two simple adjustments set the correct pitch and angle to sharpen any type of hand saw Called the Speed Saw filer, it is made by the Speed Corporation, and is reported to have been thoroughly tested by both amateur and professional wood workers

Two adjustments set pitch and angle

THERMOPLASTIC POLYBLEND

Unites Qualities of Polyvinyl Chloride, Nitrile Rubber

Combining the toughness and chemical resistance of polyvinyl chloride with the solvent resistance and flexibility of nitrile rubber, a new thermoplastic material is also unusual in that the valuable characteristics of vinyl elastomers are achieved with no liquid plasticizer The nitrile component of the material serves as a non-extractable, non-migrating, polymeric plasticizer If desired, conventional liquid plasticizers may also be added

Designated Geon polyblend 500 x 503, the new material has been especially designed for extruding and calendering, and is unusually well adapted to embossing and press-polishing operations. This should be of extreme value to the upholstery, shoe, electrical, and packaging industries. In the electrical industry, polyblend will serve as an excellent covering for cables containing vinyl insulated wires since there is no danger of plasticizer migration This elimination of plasticizer transfer is also important to food packaging and adhesive applications

The compounding, processing, and fabrication of polyblend, developed by the B F Goodrich Chemical Company, have characteristics peculiar to both vinyl plastics and nitrile rubber The stock can be easily processed either on a hot or a cold mill where it forms a smooth sheet after only one "pass," and, unlike rubber, does not require a "breakdown" period

Stocks to be press-polished after calendering may be processed like rubber at low calendering temperatures of 150 to 250 degrees, Fahrenheit If maximum physical properties are desired at the calendering operation, for such applications as films for packaging the stock should be calendered like a vinyl plastics at temperatures of 300 to 330 degrees, Fahrenheit It is interesting to note that at temperatures between 310 and 330 degrees, Fahrenheit, the transition of polyblend from a rubber-like polymer to a vinyl plastics becomes complete

SPARK-GUARD

Prevents Accidental Sparking In Electrostatic Painting

An electronic safety device so sensitive that it can be set to anticipate an accidental short, and de-energize the electrostatic field before a spark-over develops in electrostatic spray-coating and dip-detearing processes, will automatically stop the equipment should a piece accidentally approach the discharge electrode

In electrostatic spraying, special discharge electrodes are energized to bombard atomized paint with a negative charge as the particles enter the coating zone The product being painted passes through this zone on a conveyor, which, being electrically grounded, also serves to keep the piece at the opposite polarity to the electrodes This polarity differential creates a flow of charges and attracts the paint to the product with a "wrap-around" action characteristic of the process So powerful is the attraction of the field within the coating zone that some paint particles make 180 degree turns and "paint around a curve" so that paint which otherwise would become overspray contributes to the coating of the product.

In normal operation of this Ransburg process, the likelihood of any spark occurring is minimized by installing the electrostatic equipment in accordance with rules established by the National Fire Protection Association Under these rules, the electrostatic installation is engineered so that any part of the equipment which transmits electric current is separated from the products being painted or parts of opposite polarity by at least twice the possible spark-over distance

The new "spark-guard" is designed to further minimize sparking possibilities which would result from any abnormal accidental reduction of this

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16" x 6' Toolroom Lathe	1958 00

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One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors Among them are such men as Thomas J Watson, President, International Business Machines Corp, Frederick W Pickard, Vice President and Director, E I du Pont de Nemours & Co, Clifton Slusser, Vice President, Goodyear Tire & Rubber Co, and Herman Steinkraus, President, Bridgeport Brass Company

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separation It consists essentially of a self-contained control cabinet, power pack, and electronic relays arranged to de-energize the field when accidental dislocation of a part reduces the separation below safe limits The device also activates a bell and lamp to signal the operator, and can be wired to stop the conveyor or other equipment as desired

BOARD JACK

Assures Tight-Fitting Joints in Flooring or Siding

Of PARTICULAR interest to building contractors, carpenters, and home-builders is a new tool operating on the lever principle which was especially designed for quick application of flooring, siding, and sheathing with the tightest possible joints With this tool, called Bord-Jak, even badly warped boards can be forced into line and held in position for easy and accurate nailing Tongue-and-groove or square-edge flooring or siding can be brought into perfect tight-fitting alinement without hammering or battering the lumber—all with substantial savings in time, labor, and cost

It is not necessary to hammer, block, and set boards in order to obtain close-fitting joints A quick tap of the hammer against the anchor head sets it into position on the joists Lever action against the broad pressure plates

For siding, tool is used vertically

Floor-laying tool in use

squeezes the boards tightly together, and holds them in position, leaving the hands free for nailing

Spreading and squeezing joists or studs that bow too closely together can be accomplished with ease by using accessory feet which are a part of each tool, product of the Maco Corporation After true alinement has been made, studs or joists are held in accurate position until nailed or anchored to hold permanently In applying sheathing or siding, the tool is used vertically rather than horizontally

DUAL PURPOSE TOOL

Combines Hand Drill and Paint Brush Cleaner

Combining in a single unit a paint brush cleaner and a hand drill, a new device is easily converted from one application to the other by replacing the drill chuck with the brush-clamp attachment, or vice-versa The gear ratio is eight to one, as a drill, the unit, produced by Home Utilities, Inc, will bore holes up to a quarter inch in diameter

As drill (right)—brush cleaner (left)

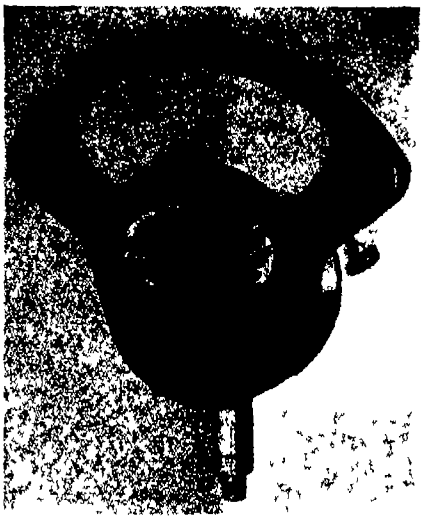
DIAL INDICATOR

Has High Amplification Ratio For Greater Accuracy

Said to extend the field of accuracy which can be covered by a wholly mechanical dial indicator, a quadrant-type dial indicator which has standard mounting dimensions is suited for use on comparators and on fixtures for controlling especially close tolerances

The indicator, called Micronar, has an unusually high amplification ratio for an instrument of the dial indicator type The scale of the English unit model is divided into 0001 inch steps and in the central portion these intervals have been subdivided to 00002 inch Consistent repeatability and accuracy in keeping with these fine divisions is claimed The effective range is 0018 inch, considered adequate for the fine checking for which this instrument is intended

The working advantages of Micronar, made by the Standard Gage Company, Inc., include a light-weight hand which is instantly responsive and reaches its final position without noticeable fluttering The dial is rotatable over a small angle by means of a fine adjusting screw which facilitates setting the instrument to a standard The Micronar is regularly furnished with a sapphire tipped contact point for wear resistance In addition to the English model there is available a metric model graduated in 001mm and having a range of 04mm



Indicates without noticeable flutter

ALUMINUM PAINT

Dries Fast, Resists Attack By Most Chemicals

Made with a corrosion-proof, synthetic resin vehicle and a special aluminum powder that leafs well, an aluminum protective coat offers advantages not obtainable with ordinary aluminum paints Since aluminum is acted upon by both acids and alkalis, and since there are nearly always at least some traces of chemicals in the atmosphere of every industrial plant area, the encasing of the aluminum particles in an acid-, alkali-, and waterproof synthetic resin vehicle protects the leafed aluminum from any dulling corrosive effect Further, since the synthetic resin vehicle transmits approximately 95 percent of the visible light (in contrast to the dark amber color and lower light transmission of conventional aluminum vehicles), this coating, called Prufcoat Aluminum, actually is brighter in the first place

The leafed aluminum particles plus the polymerized Prufcoat vehicle not only provide protection against acids, alkalis, and water, but also seal in all average surface conditions Thus, Prufcoat Aluminum can be satisfactorily applied to any general maintenance surface that is dry and reasonably free of rust and foreign material (oil, grease, tar, and asphalt) The resultant coating also keeps moisture and other corrosive agents from reaching the surface

The volatile solvents in Prufcoat Aluminum evaporate sufficiently within a few minutes after application to leave the coating dry to the touch It can rain within a matter of minutes

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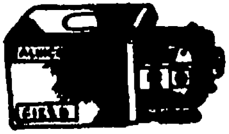

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after the paint has been applied with no adverse effect upon the finished job This fast air-drying characteristic also makes the coating unusually interesting for production line painting where it is desired to paint sheet metal products, and either keep a production line moving or to handle the painted product within a matter of minutes

SOLIDS-HANDLING PUMP

Designed For Minimum Dilution, Has Longer Service Life

INTENDED for applications where dilution must be kept to a minimum, even though it may result in reducing the life of the sleeve and packing, a new type of solids-handling pump with a special back cover allowing for two rings of packing between the seal cage and the area of the casing in back of the impeller has no stuffing box wear plate This solids-handling pump, produced by the Allis-Chalmers Manufacturing Company, is an addition to the line of pumps produced by that company for several years, which has its seal cage immediately adjacent to the area of the casing in back of the impeller This latter unit has been used in pumping such solids as slurries, tailings, pulps, sludges, and so on, where materials must be kept out of the stuffing box, regardless of dilution, or where dilution is not considered to be a disadvantage

Combining a special design plus a new, highly abrasive-resistant alloy this solids-handling pump is said to outlast ordinary pumps two to four times, and is available in capacities from 175 to 7000 gallons per minute at heads through 100 feet

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It is available now in 12-ounce packages, one package being adequate for an average room This package consists of a cloth sack containing the product, and an outside container made with a vapor-proof aluminum foil lining The user simply removes the outer container and hangs the cloth sack wherever needed

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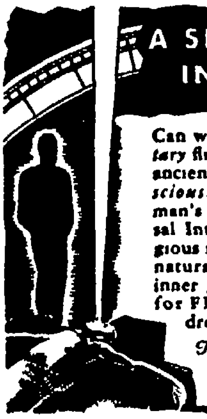

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TEXTOLITE LAMINATED PLASTICS This 64-page booklet lists 44 different grades of this sheet material with their electrical, physical, and mechanical properties as well as information on the manufacture, application engineering, and properties of each type *General Electric Company, Chemical News Bureau, Pittsfield, Massachusetts —Gratis*

PEDESTAL SPOT WELDERS Describing a line of welders built on heavy duty principles and equally adaptable for miscellaneous spot welding and for high production work, this bulletin presents specifications, drawings, and details of the available types and sizes Request Bulletin No 503 *Progressive Welder Company, 3050 East Outer Drive, Detroit 12, Michigan —Gratis*

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INVESTIGATION OF THE STRENGTH OF RIVETED JOINTS IN COPPER SHEETS, by W M Wilson and A M Ozelsel, is a bulletin based on the findings of tests conducted by the Engineering Experiment Station of the University of Illinois Request Bulletin No 360 *University of Illinois, Engineering Experiment Station, Urbana, Illinois —Gratis*

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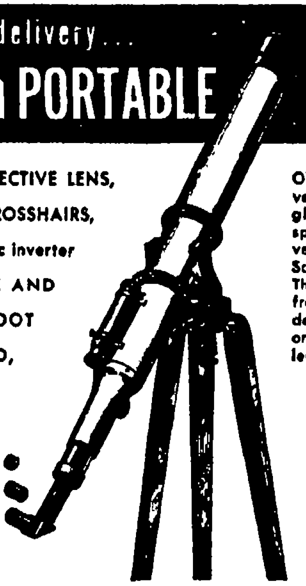

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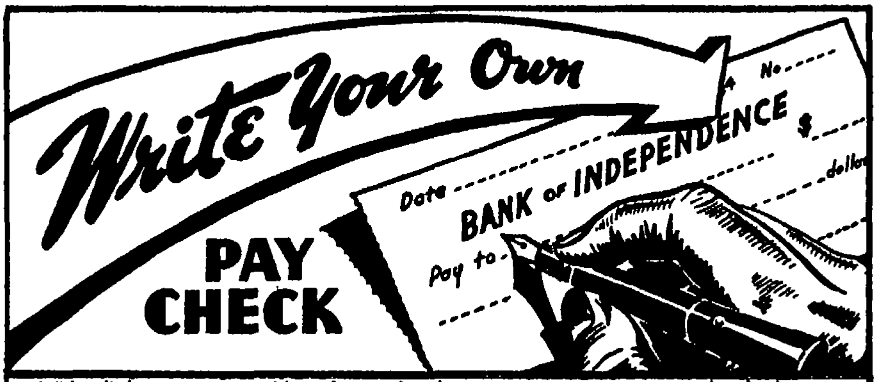

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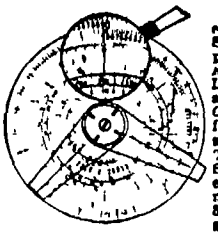

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MAKSUTOV, pronounced Mack's-suit-off, is the name given to a new type of telescope originated by the Russian of that name As soon as Maksutov published basic data for the design, this department facilitated the construction of Maksutov telescopes by inviting N J Schell, Beaver Falls, Pa., experienced amateur telscope maker, to interpret Maksutov's abstruse original article for other amateurs and by arranging with the Corning Glass Works to mold 24 of the special blanks needed for the construction, all of which are now in various amateur's hands

First to furnish a description of a finished Maksutov telescope is G Camilli, 155 Dawes Ave., Pittsfield, Mass., who enthusiastically reports the "Mak" a success Some are still having difficulties with the extremely sensitive alinement after nearly finishing their Maks Camilli writes

"The optical system developed by D D Maksutov of the State Optical Institute, Moscow, U.S.S.R., is similar to the Schmidt camera and combines the action of a single meniscus lens with that of concave spherical mirror The role of the meniscus is identical to that of the correcting plate of the Schmidt camera—the correction of spherical aberration and coma of the spherical mirror without introducing a noticeable chromatism

"The meniscus shuts the tube and makes possible a sealed instrument free from convection currents and a mirror protected from dust and dew, in addition, secondary mirrors may be fastened to the meniscus to reduce their diffraction effects

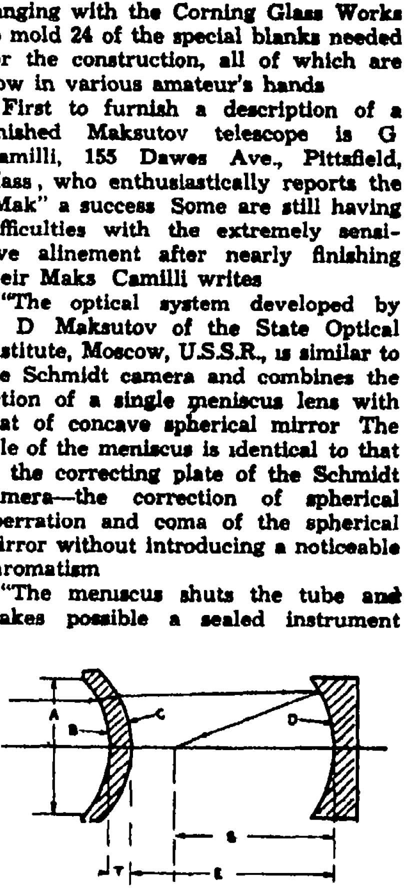

Figure 1. Maksutov system, Camilli. A = 8". B = 12.224". C = 12.668". D = 66.856". E = 43.128". T = .800". S = 33.6"

"The Maksutov system was described first by Maksutov in the *Journal of the Optical Society of America*, 1944, May, and subsequently by N. J Schell in Scientific American, 1944, October and December

"The optical system of the Mak completed by the writer is shown in Figure 1 In common with other members of the Mak group, the telescope has an aperture-focal ratio of 1.4. It can be used for visual and photographic purposes

Figure 2: Camilli's solution of the supersensitive alinement problem

"The meniscus is made of crown glass (n_D = 1.5170 ± 0.0010, V = 64.5 ± 0.5) and was ground, polished, and figured against a tool of the same dimensions Both surfaces of the meniscus are spherical The convex surface of the meniscus needs no accurate figuring since the curve is very deep This is one of the attractive features of the Mak design. Deep curves of this kind can be held truly spherical with reasonable care in the grinding and polishing, especially when it is known that a sphere is aimed for A light polishing action has been found to be best.

"The spherical mirror is made with radius of curvature held as closely as possible to the dimensions shown in Figure 1 The success of this job depends very much upon holding radii very close to those called by the design theory Unlike our ordinary telescope mirror jobs, where we get a certain radius and then correct to the extent called for by the actual radii obtained, this work is more like that of refractors where close adherence to radii as computed must be had if correct results are to be attained. For the above purpose a spherometer ('A.T.M.A.,' 242) is almost a necessity The meniscus must be optically centered by edge grinding.

"In the writer's optical assembly shown in Figure 2, the meniscus and the mirror are rigidly mounted in an aluminum frame. This method affords great simplicity in the mounting and adjustments of all the parts. Thus the cells for the meniscus and the mirror, as well as the spider that supports the

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diagonal, can be slid up and down on the rods of the frame The frame will be found very useful during the final phase of the assembly To obtain the best performance from the Mak system it is imperative that the optical axis of the meniscus and of the mirror coincide This adjustment is of course done with the spider and the diagonal removed from the assembly By providing three small bushings which are held against the cell of the meniscus, this and the spider can be removed and returned exactly to the original accurate position without injuring the optical alinement of the parts.

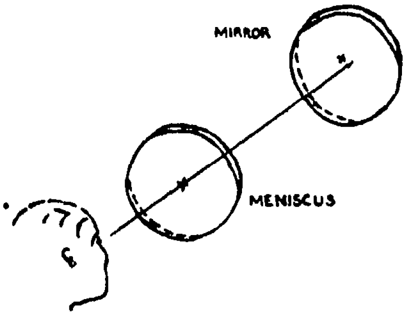

Figure 3: Getting axis alinement

"A method of obtaining the alinement of the two optical axes (mirror and meniscus) is shown in Figure 3 Using a wax-pencil, a cross is marked on the convex (back) surface of the meniscus Likewise a small round dot is marked on the exact center of the mirror A light held slightly on side of the operator illuminates the front of the meniscus Looking at the system from the meniscus and keeping his right eye in line with the center of the cross and the dot on the mirror, the operator will see also the reflection of the cross on the surface of the mirror By careful adjustment of the mirror, the reflection of the cross can be made to coincide with both the original cross and the dot of the mirror In making this adjustment it is of course assumed that the meniscus is squared on the mechanical axis of the frame

"After this adjustment has been completed, the spider is returned to place and the assembly is inserted in a protecting tube as shown in Figure 4. The adjustment of the diagonal with respect to the mirror is done in accordance with one of the schemes described in 'A.T.M.A.,' 272

"The performance of the Mak well repays all the work which the writer has put into it—the definition is much superior to that obtained by a simple reflector The images of stars are very small and sharp, free from coma and color The writer expects to run a series of comparative tests between the Mak and an $f/17$, 8½" reflector, the mirror of which is made of fused quartz, mounted in tandem with the Mak.

"The mounting for this telescope (Figures 4 and 5) is similar to Everest's 'Old Town Pump' described in 'A.T.M.A.,' 514 An Alnico motor (75 r p.m), through an additional gear-reduction, drives the final worm gear of the telescope (Figure 5) The same

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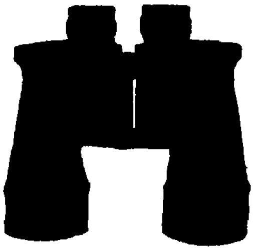

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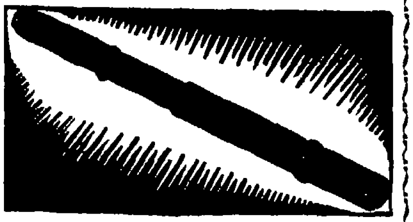

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Figure 4: Tube protects assembly

CONFUSION exists in some minds regarding the type of Pyrex Brand glass in standard molded telescope blanks Are these regular products or some "off" variety?

Figure 5: Detail of the mounting

Such a rumor probably started from the fact that Corning developed for the 200" mirror a special glass having only two thirds the expansion coefficient of the standard Pyrex. While this special glass is available for to-order jobs, it is much more expensive The regular type in standard molded mirror blanks, 4¼" to 12½", also the 16" blanks recently made for special price club groups, is the same as used in Corning's huge annual tonnage of Pyrex Brand laboratory glass, cooking ware, insulators, and other industrial and consumer ware It is drawn from the same tank furnaces and from the same melts in them If a farmer, milk-

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ing a cow, directs a squirt into a cat's mouth, the milk is from the same cow, same bag, same batch, and has same composition, and Corning mirror blanks are as completely regular material as the milk squirt is the cow's regular product. This also explains why Corning molded telescope blanks can be as inexpensive as they are, since the regular glass used in immense quantities for products having large sale, is *always in continuous melt*

Not all may even yet know how large an industry Corning Glass Works is They have 10 plants, make more than 37,000 different items of glass including 45 percent of all the glass bulbs for incandescent lamps made by others in the United States, and do a $50 000,000 annual business of which telescope blanks is fractional

Let's look at the two kinds of Pyrex Brand glass mentioned above Wide awake telescope makers will learn their numbers

	Brand 774 (Consumer ware and telescope blanks 4¼"—16")	*Brand 716* (200" and to-order telescope blanks)
Softening point	820°C	832°C
Annealing point	555°	535°
Strain point	515°	493°
Expansion	$32 5 \times 10^{7}$	23×10^{7}
Density	2.23	2 16
N_D	1 474	1 464

The ratio of linear coefficients of expansion is seen to be as 00000325 is to 0000023 or as 33 is to 23—about as 3 is to 2 In ordinary conversation glass technologists say merely "expansion 33" or "expansion 23,' and on the same scale fused quartz (silica) has expansion 5 and plate glass 90

Why, you may now wish to ask, couldn t Pyrex Brand No 716, the lower expansion brand, be just as easily used in telescope blanks as the 774? Because it isn't in continuous melt Much of it is in stock but it is cold Obviously the telescope demand wouldn't begin to justify keeping it in continuous melt, and melting it is expensive in more practical ways than the one that is most obvious from the table—that is, higher softening point (more fuel) This softening point is only 12°, Centigrade, above that for Pyrex 774 but at the top temperatures involved this increment is appreciable It took five weeks to melt 60 tons of 716 from which to dip enough to fill the mold for the 200" mirror

When an order for a blank of Brand 716 is filled, a special ceramic mold is built up, large irregular pieces of 716 are laid in it, cold, and melted down to shape of mold In practical ways this is expensive For example, a single blank of 716, 16" by 3 1/3", was priced as of last spring, $198, and a 20 by 3 1/3" was priced $306 In a club group of 24 blanks molded at one time the 16" blanks of 774 sell for $37.50 net

This department has now been urged to start a club of purchasers of 20" mirror blanks, as it did with 16' blanks Investigation revealed that the economics in the two cases were dissimilar, with heavy accent on the dis, and no such club is in the offing

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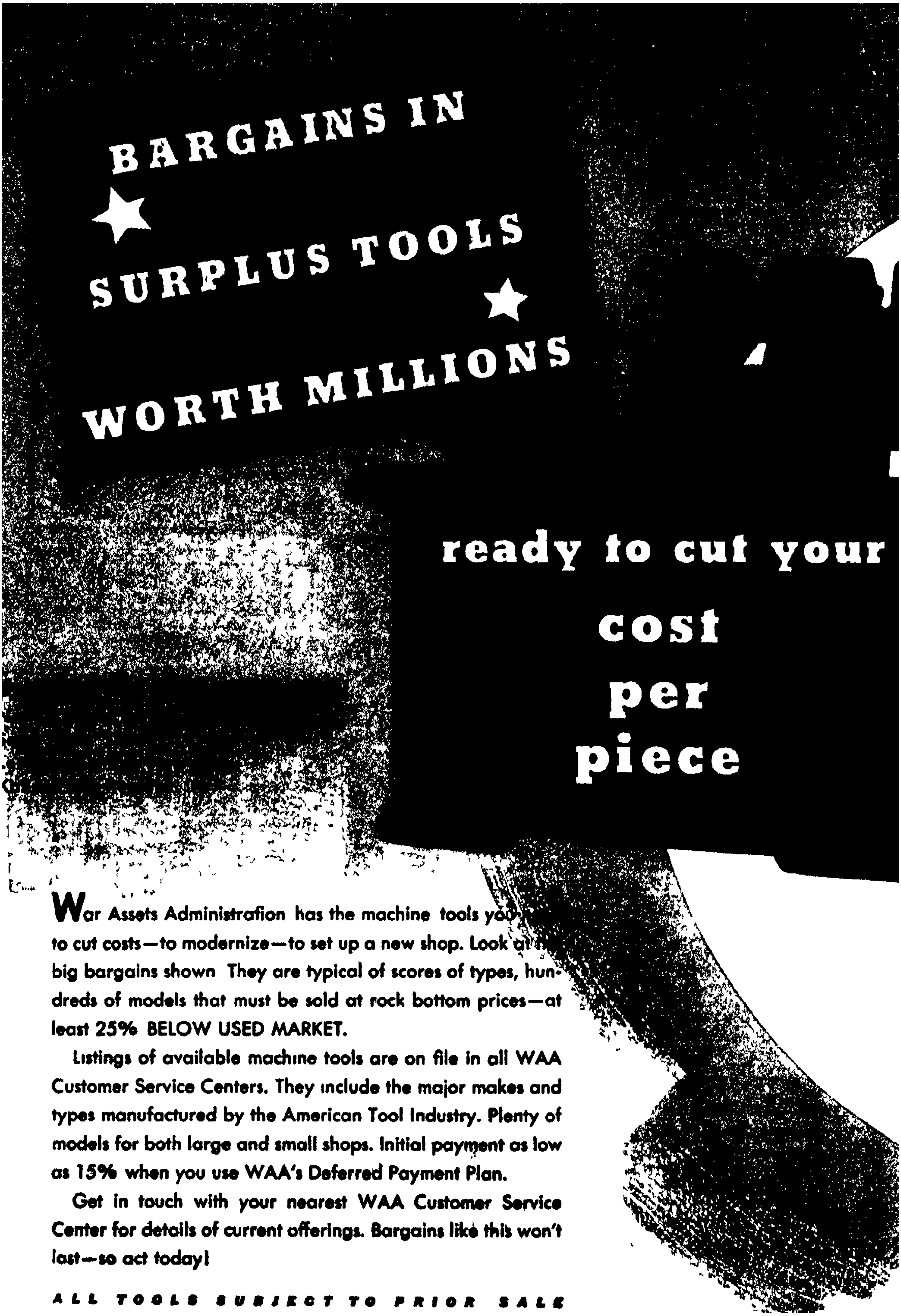

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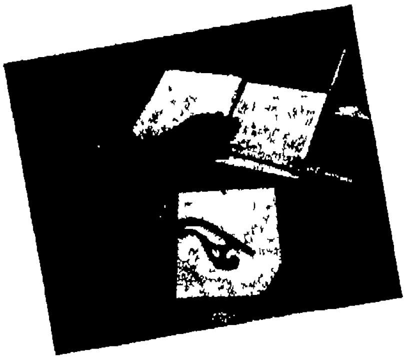

Industrial Dreamer Armed with the tools of his trade, the engineer portrayed on our cover symbolizes the impact which his profession can have on this nation's industrial future On page 197 Carl J Lamb, himself an engineer, drives home pertinent points.

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50 Years Ago . . .

(Condensed from Issues of November, 1897)

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100 Years Ago . . .

(Condensed from Issues of November, 1847)

GLUED FABRICS — "A patent has been taken out for dispensing with sewing in the manufacture of shirts, collars, and linen articles The pieces are fastened together with indissoluble glue"

LIFE RAFT — "Recently we saw a mattress enveloped in an india rubber cover, and it floated about in the Mississippi, with a man upon it, with all safety Their introduction on board our steamboats would relieve passengers of much of the anxiety arising from accidents to the vessels, as they would be the certain means of safety whenever it became necessary to leave the boat."

ICE — "From a table in the Boston Shipping List, we learn that for the month ending October 31, 3206 tons of ice have been exported from this port, of which 1363 tons went to Calcutta, and the remainder to the south and to the West Indies."

PHOTO RECORD — "M. Brunel, a contractor on the Italian and Austrian Railroad from Florence to Bistaja, has a daguerreotype picture sent him every evening, which represents the state of the works at the point where it was taken. Thus he has at the end of every day exact information of the progress of the style in which the building has been conducted."

YOUR TELEPHONE TRANSMITTER AND RECEIVER, *voice gateways to the telephone plant, are so essential to satisfactory service that they have been under study in Bell laboratories for seven decades*

TESTING TELEPHONES BEFORE THEY ARE BUILT

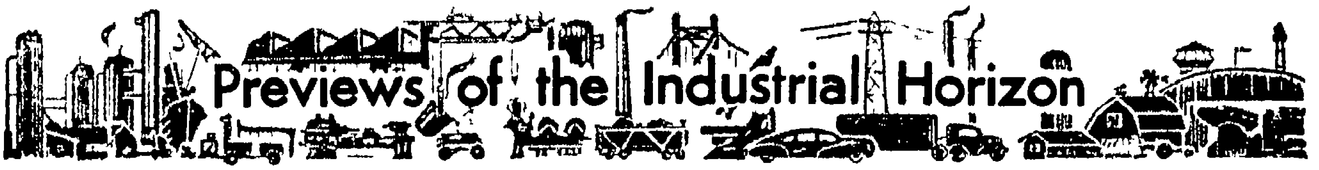
A TELEPHONE RECEIVER is a complex system of electrical and mechanical elements Its coils, magnets, diaphragm and cap react on each other as they convert the electrical waves of your voice to sound waves What is the best size for the holes in the ear cap? Will 1/1000th inch greater thickness help a receiver diaphragm to carry your telephone voice more clearly? One way to find out is to build numerous experimental receivers and test them

But Bell Laboratories have found a shorter way They built an all-electrical replica, an "equivalent circuit" in which electrical resistance stands for air friction in the cap holes, capacitance corresponds inversely to the stiffness of the diaphragm Over all performance of this circuit can be quickly measured and design changes economically explored Later, a model can be built for final check

The "equivalent circuit" was pioneered by Bell Telephone Laboratories 25 years ago It is a useful tool in many Laboratories developments—saving time, saving the cost of machine-tooled models, encouraging experimentation It is one more example of the way Bell scientists get down to fundamentals as telephone progress continues—and service keeps on improving for all subscribers

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE



Previews of the Industrial Horizon

By A. P. Peck

SMALL BUSINESSES THRIVE MIGHTILY

Many a pessimistic view of the future of industry in these United States, despite anti-trust and similar laws, foresees a rapid decline in "small business" and an equally rapid gobbling up of the lion's share of industrial profits by huge and heartless corporations

Reference was made to the fallacy of this view on this page, December 1946 issue, now let's look at a few new figures which show the extent to which government buying is being tossed to small business groups. In fiscal 1947, small businesses received more than 55 percent of federal contracts of the sort they could handle, in the middle '30s they averaged about 25 percent of the same type of orders In dollars, the fiscal 1947 business given to small manufacturers and suppliers by federal buyers amounted to $777,000,000

Another angle of the same situation, but differing in a matter of degree, shows that the independent makers of automobiles—Hudson, Nash, Crosley, Studebaker, Willys-Overland, Packard, and Kaiser-Frazer—have grabbed a large share of the present automobile market, the largest, in fact, that they have been able to serve since 1931

Looking at the industrial horizon through such facts as these, it becomes apparent that our industrial economy is not yet going to the infernal bow-wows via the dread octopi of ruthless big business

WEED CONTROL

Success during last summer of the use of a form of 2,4-D as a large-scale weed killer on 18,000 acres of corn in Kentucky adds one more laurel to the crown of applied science In this case, $2,000,000 worth of corn was saved from total loss through the expenditure of less than $10,000 for applying weed-killer The chemical destroyed the weeds yet saved the corn when a series of excessive rains prevented normal cultivation and permitted weeds to grow so rapidly that they almost completely covered the corn itself

OIL IS WHERE YOU FIND IT

In any consideration of the future of the petroleum industry, figures are freely bandied about which can be made to show that our earthly oil resources will dwindle to zero within the next generation—or that they are virtually inexhaustible! It all depends on the point of view, even when coal and shale are barred from the discussion as sources of liquid fuels.

Exploration for new oil fields goes on apace, all over the globe And right close to home things are happening that may seem to becloud, but actually can brighten, the petroleum horizon Thus, the Leduc field in Alberta, Canada, is already producing fair quantities of oil, surveys are daily extending the potentialities South of the border there are the unexploited and largely unexplored Mexican oil fields, largely shackled as yet by political and economic considerations Within the continental limits of the United States, oil geologists are emulating a combination beaver-gopher in their industrious probing for new sources to exploit

It is still anybody's guess as to the actual extent of this planet's oil reserves, whether in the form of crude or otherwise In any event, assurance can be had that the aggressiveness of the petroleum industry as a whole will squeeze the last drop of crude from the earth before it cries quits

INDUSTRIAL CONSULTANTS

Typical of the results that may be expected when a manufacturer employs a specialist consultant to perfect a product is the announcement of a new water-dispersed paint received too late for inclusion elsewhere in this issue This paint, which dries in less than half an hour without odor, yet reportedly possesses the durability and finish of high-grade oil paints, has as its vehicle a dispersion of totally synthetic resins in water, plus a pigment and a synthetic wetting agent.

What makes this development a bright spot on the industrial horizon is the fact that the manufacturer, Shawinigan Products Corporation, conceived the original idea, carried it through the early experimental stages, and then turned the whole thing over to a group of independent chemical consultants, Foster D Snell, Inc , to perfect the experimental product

Moral of this little industrial success story is that it usually pays in the long run to make use of specialized services, even though a manufacturer may think that his staff should be adequate to carry a project through to completion An outside viewpoint, unhampered by company tradition or other handicaps, can often produce better results more economically

STRAWS IN THE WIND

Vacuum hoses are being used more and more widely for handling various types of materials in industry, latest application is in unloading fish from boats, where a million fish can be handled in one sixth the time required by hand methods   Present air cargo rate-cutting war is a good way of hindering progress, raising accidents per ton mile   Comparative time-and-motion studies in small home construction shows promise of cutting costs, increasing efficiency of an inefficient operation   Lightning rod manufacturers expect 1947 to be a banner year, more and more industries are becoming conscious of lightning hazards and of means of protecting against them   Glues, whether animal or synthetic, can be given pleasant odors by suitable treatment

Scientific American
NOVEMBER • 1947

ENGINEERS will mold the FUTURE

If Available Resources of Engineering Brains are Properly Used, They Can Go Far Toward Replacing Certain Dwindling Natural Resources With Engineers Showing the Way, and Management and Labor Co-Operating, American Industry Can Reach Even Greater Heights of Efficiency and Productivity Than Ever Before

*By Carl J. Lamb**

In a remarkably short space of time this country, founded by refugees and starting from scratch, has become the most powerful in history A nation has developed which leads the world in the fields of power generation, mass production and continuous processes, and the mechanization of industry, among many others And it possesses not only great material wealth but an even greater wealth of engineering knowledge, ingenuity, and daring

Because nature blessed this nation with great natural resources, lip service has been given to conservation, but it has not really been practiced Now, after two World Wars in a third of a century, appears a real dilemma, not yet widely appreciated The United States is no longer a "have" nation with respect to mineral resources, many minerals whose ample supply has always been taken for granted are now depleted and substitutes must be found for them in the future

Everyone today is conscious of high prices Real estate, labor, and material costs are at such levels that industry is faced with vastly higher investment costs for buildings, machinery, and equipment, together with materially increased operating costs Based upon present conditions and the past record of technology, it is evident that there is great need to utilize the country's engineering resources to the utmost. If present income levels and high standards of living are to be maintained, it will be necessary to replace obsolescent plants and equipment, to reduce both investment and operating costs drastically, to develop the use of more abundant materials, and to engineer new processes and techniques or to materially modify old ones Anyone who is doubtful that this can be done—if the problem is properly approached—has only to review the history of the development of this great industrial and mechanical nation to realize that its engineers can continue to perform miracles in the future as they have done in the past.

Up to the present time, full consideration has not been given by industry to means of reducing building and power costs, primarily because such costs until recently have not been of sufficient comparative magnitude to emphasize the necessity for so doing, or have not been considered fully on the basis of engineering economics The greatest war effort ever known has just been concluded, for seven years engineers gave first consideration to maximum production rate, ability to operate under a wide range of atmospheric conditions, resistance to corrosion and shock, to minimum weight and space requirements, and so on The question of cost was only of minor importance Many able and experienced young engineers, purchasing agents, and salesmen have neither an actual first-hand knowledge of cost-reduction nor a full realization of its importance

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*Staff engineer, Douglas M McBean, Inc Consulting Engineers

ECONOMY ESSENTIAL — Conversion from a war- to a peace-time economy is still under way Those considerations which should always guide product and design engineers must be re-established—lowest possible first cost, reliability, performance, long life, and appearance This is mandatory not only so far as manufactured products are concerned, but also with respect to the plant in which they are produced and the machinery or process employed Engineers should now be better prepared than ever before to undertake their assigned tasks because to their great store of peace-time knowledge and experience has been added a vast fund of war-time accomplishment which can be invaluable as a guide to the improvement of old practices and the development of new ones

An obvious departure from pre-war conventional plant design practice, and one method worthy of serious consideration is quite simple It consists of so engineering buildings, equipment, machinery, and processes as to save both the utmost space and weight, consistent with efficient operation and adequate accessibility Too many plants have been (and still are being) engineered without serious consideration of the cost benefits to be obtained by such reductions in weight and space Most machinery weights and dimensions are reduced appreciably as speeds are increased. Then, too, certain pumps, heat exchangers, and other machinery may frequently be mounted advantageously in vertical rather than in horizontal positions Continuous processes require materially less space than do batch ones and are lower in first cost High steam pressures and temperatures result not only in lower fuel costs, but also in reduced weight and space requirements in steam plants. Many types of machinery, particularly power generating equipment, have become so reliable that it is no longer necessary to provide spare or stand-by units Proper consideration and use of such facts as these, by responsible engineers, may produce appreciable savings in size of buildings, thus, greatly reduced first costs may frequently be attained without sacrifice of efficiency—and often with a gain It is obvious that a saving of 10 percent, for example, in floor space required for equipment to perform a certain operation means a corresponding reduction in cost of real estate, foundations, and building

During the war the Army needed emergency floating power houses Gielow, Inc, naval architects, designed power barges, each of 37,500 kilovolt-ampere rating, which could be towed to desired locations, and which performed invaluable service There is available a large surplus fleet of Liberty ships, some of which might be converted to permanent generating stations, or, as was the case with the S S *Jacona*, previously converted by Gielow, to portable ones Such plants built in surplus ships should be completed more quickly and at lower certain cost than could new land stations

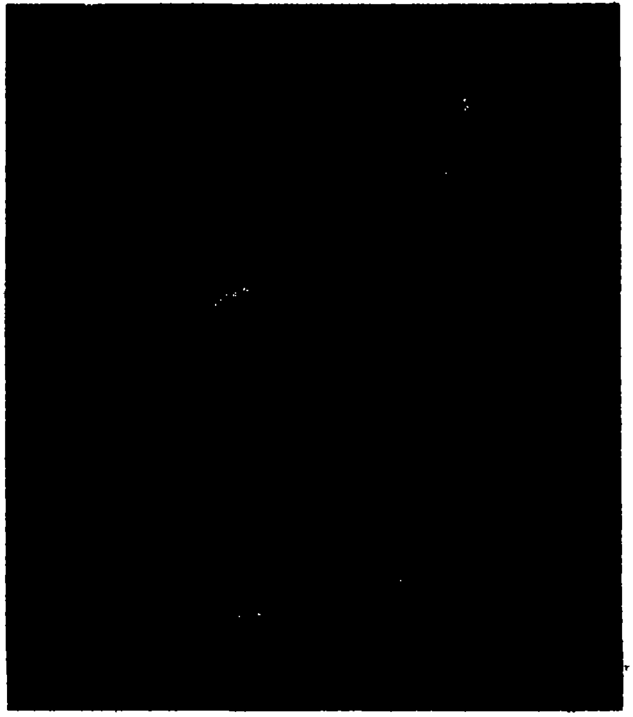
Entirely aside from the power house or boiler plant, there is a great opportunity to reduce costs in the production line or process plant, not only when designing new establishments, but particularly when examining existing ones with critical eyes. During the recent war, for example, a Westinghouse electronic tube plant was faced with the problem of multiplying production of large tubes in the existing space available, without any possible expansion of

Courtesy Hydropress, Inc

A 4000 ton extrusion press which promises new uses for tubes of nickel and steel alloys

Pilot plant for research on coal-burning gas turbines. Left: Fly ash separator. Center: Combustor and instrument panel. Right: Coal feeder system

Courtesy Bituminous Coal Research, Inc



area Because the operation of sealing glass to metal had been done by machinists, it was natural that such work should be done in horizontal lathes. The responsible production engineer rose to the occasion and developed vertical lathes for the purpose, with astonishing results. They occupied only a fraction of the space taken up by horizontal ones, and the actual production achieved in the same working space was eight times that previously attained

NEW MATERIALS FOR ENGINEERS — Because of acute shortages of various metals, great advances have been made in the use of the light metal alloys The wider use of magnesium alloys as engineering materials by the Army and Navy will broaden the fields of their industrial use and should reduce their costs In a recent paper presented before the A.S M.E., H A Lorant, Chief Engineer of Hydropress, Inc, announced results obtained by the International Nickel Company with a 4000 ton extrusion press producing tubes of nickel and steel alloys This engineering development makes possible for the first time the economical production of tubes and profiles in special alloys of steel and nickel, which previously could not be formed. Due to war-time shortages, Linde Air Products developed synthetic sapphire, ruby, and spinel gems for engineering use These synthetic stones have been used for micrometer and precision gages, extrusion dies, thread guides, cutting tools, and fuel and injector nozzles In addition to other possible uses, sapphire balls for high speed ball bearings are now being produced, thus making possible the use of ball bearings in corrosive atmospheres, at high temperatures, or in vacua, again opening new vistas for the engineer in the design of new and improved machines

While it has been said for years that the world is rapidly using up its supplies of petroleum, the time has arrived, apparently, when a shortage actually exists Pittsburgh Consolidation Coal Company is erecting a laboratory and pilot plant to produce liquid fuel oil and gasoline from coal Then, too, the Locomotive Development Committee of Bituminous Coal Research, Inc, has for the past two years been carrying on an intensive research program which is now culminating in the building of two large coal-burning gas turbine locomotives They have successfully demonstrated in a one-third scale pilot plant a system of pulverizing coal, burning it, and separating the fly ash to such an extent that abrasion of the turbine blades is no longer a serious problem The relations of railroad fuel costs and locomotive efficiencies are such that a rail horsepower-hour costs

Courtesy Westinghouse

Above: Sealing the ends of a high-power radio transmitting vacuum tube in a vertical glass lathe of a type that was developed to take up less floor space than horizontal lathes such as shown in the photograph at the right. Through this engineering application, tube production was multiplied eight times in the same working space. The vertical lathes also reduce "set-up" time for each tube

about 0.57 cent for fuel in a conventional steam locomotive, and 0.53 cent for fuel and lubricating oil in a Diesel locomotive, whereas the coal-fired gas turbine locomotive should produce a rail horsepower-hour for only 0.20 cent.

A major asset of the gas turbine in directly utilizing coal as its fuel is the very large amount of excess air which is necessarily employed. This tremendous amount of air makes possible the "freezing" of the ash in the form of tiny particles, rather than as liquid slag, and a heat release rate of 1,000,000 Btu per hour per cubic foot of combustor space can easily be attained, as compared with a maximum of 50,000 Btu in industrial coal-burning boilers. It is believed that the coal-burning gas turbine will find application in land and marine power plants as well as on the railroads, because of its unique ability to produce power at good efficiency from low-cost fuel without the necessity of using water.

ENGINEERING CASE HISTORIES—Recently a textile manufacturer asked our firm to undertake a survey of the glove and mitten departments, and submit recommendations for the additions necessary to increase production materially, with the objective that such expanded production would not increase costs excessively. As a result of this survey and a revised production layout, it was possible to increase production by 68,000 dozen pairs of gloves and mittens per year, without any addition or increase to building, floor space, or personnel.

In another case, we were called upon by the Richardson Corporation, large producer of soda fountain syrups, and with the co-operation of the Richardson organization were able to plan an approximate production increase of 100 percent, at the same time releasing 1/3 of the existing floor space for future expansion. This was done in what was formerly considered to be an overcrowded plant. The resultant large increases of production, with consequent cost-reduction and without increase of floor space, in both of these cases were accomplished by rearrangement of production lines, speeding up some operations, improving certain details, and changing others. In each case a small amount of obsolescent equipment was, naturally, replaced.

Due to the energy and ambition of business men in general, many existing large manufacturing plants were neither designed nor planned, but like Topsy "just grew," their success resulting from the personal ability of the individual management. Probably 25 percent of the industrial plants in the United States could profit to the same degree as the two above, if they made good use of engineering brains, experience, and progressiveness, and at least another 25 percent suffer from obsolescence.

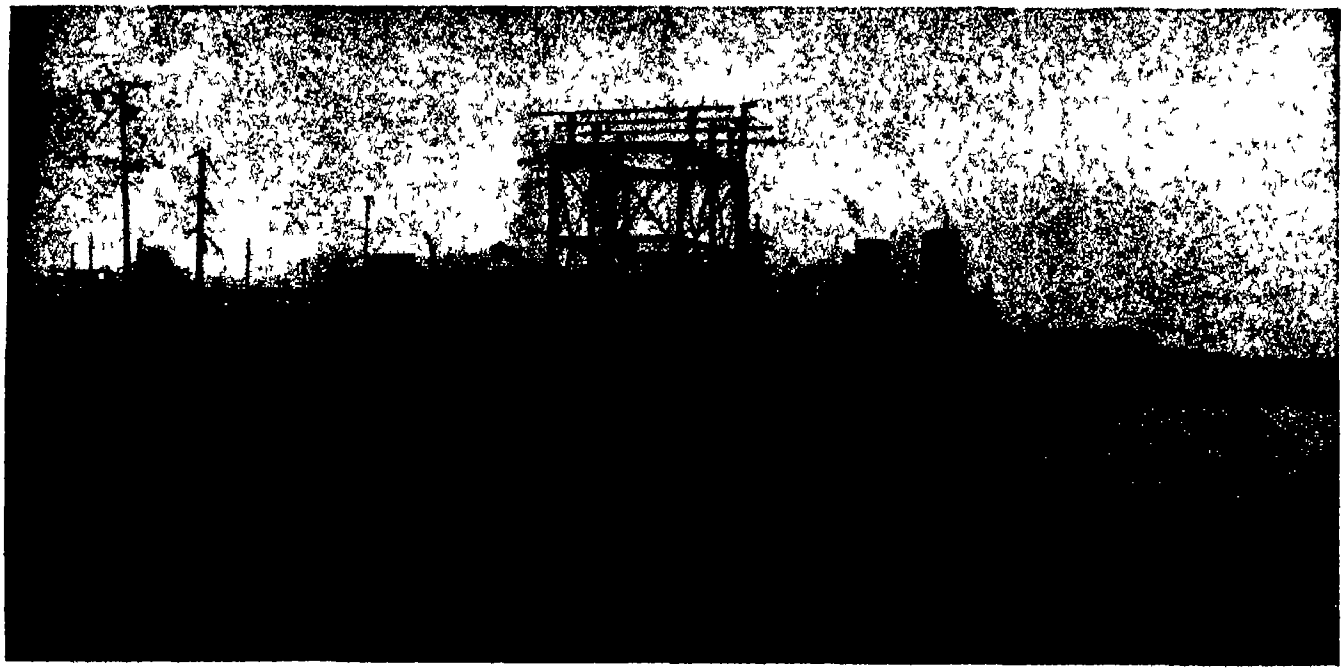
In life as it is today, industry cannot stand still. It must either go forward or backward. The surface of applied engineering or knowledge has only been scratched. The responsibilities of engineers in American life have become greater, and must continue to increase if national progress is to continue.

High wages and short working hours, with the present high standards of living can be maintained—or raised even higher. In order to do so it is necessary that engineers continue with such developments as have been briefly sketched here, that labor buckle down to produce a fair return for its wage, and that management improve its present performance and plan constructively for the future.

The force—the power—the greatness—of this nation do not depend upon a few great leaders, upon winning wars, nor upon the adoption of new economic theories. The importance of the United States to its people and to the world is, and will continue to be, the result of the average of accomplishment by engineers, laborers, management men—all its citizens—each in his own field and each working vigorously to obtain the maximum results in that field.

Courtesy Gielow, Inc

Floating power plants can be built in surplus ships more quickly and at lower cost than new land stations



Wool + Heat + Pressure = Felt

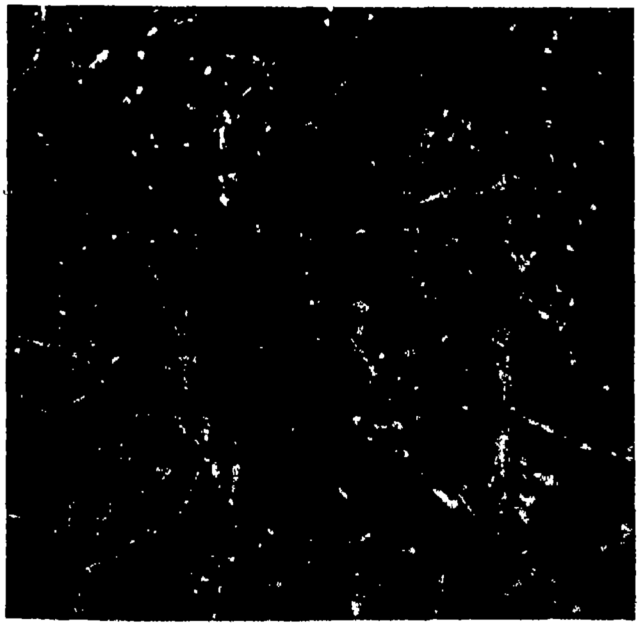
**Felt, Most Ancient of Textiles,
Has Become an Important Material of Modern Engineering. Covering a Wide
Range of Characteristics, Felts Are
Now Available for Fabricating a Great Variety of End Products**

By Edwin Laird Cady

FELT was the first textile worthy of the name. Indeed, the first spun yarn probably resulted from experimentally felting a small wad of wool by rubbing it between the palms of the hands.

When a desert-dwelling Mongol wants a new piece of material for his tent, he lays an old piece flat on the ground, covers it with a thick layer of loose wool, and rolls it up around a wooden pole long enough so that both ends will protrude from the roll. Then he ties a rope around the roll to hold it together, hitches the traces of his horse to the ends of the pole, and utters the Mongolian equivalent of "giddap." The horse moves forward, the roll is rolled along the ground. After a few miles the horse is stopped, the rope removed, the roll unrolled. What had been loose wool now is brand new felt—warm, wind- and rain-resistant, and hard or soft in accordance with whether the roll was rolled a long distance or a short one.

Photomicrograph of felt shows the interlocking fibers. Oval spots at several points are particles of oil entrapped by the material



The Mongol has no microscope to tell him that each wool fiber is covered with small scales which interlock and hold tightly as his rolling action forces the fibers to penetrate the mass and entangle each other. But those interlocks are the reasons why new felts and new uses for felts are constantly being presented to industry.

Thus while our Mongol is rolling his bundle across hot sands, checking occasionally as he rides to see how much heat and pressure and work his felt is getting, American felt mills are using those same three factors plus chemistry and cleanliness. The modern felt mill is equipped from end to end with automatic controls, instruments, inspection devices, highly skilled men. It can turn out felts ranging from those as soft as dress fabrics to those as dense as hard wood. It can meet specifications laid down by the Society of Automotive Engineers and prove them by tests established by the American Society for Testing Materials. And with all of this it can make so many different special felts of controlled qualities that no catalog ever has attempted to list them all.

FIBER MIXTURES POSSIBLE — The interlocking abilities of the wool fibers can hold more than the wool itself. Wool felt can be admixed with as much as 80 percent of some other fibers, both natural and synthetic, although fibers such as nylon have such low coefficients of friction that only a 35 percent admixture seems to be practical at the present stage of development.

Among the synthetic fibers so admixed are viscose rayon, plasticized acetate rayon, vinyon, aralac, high tenacity rayon, and nylon. Cotton can be used as the sole admixture, or can be used in addition to silk or any of the synthetics. The mixture is worked out to have the wear resistance, permeability, absorption capacity, chemical resistance, strength, or other physical properties needed by the product into which the felt is to be made or in the processing of which it is to be used

By making batts of the synthetic fibers and then applying heat and pressure to them, a felt-like material which contains no wool can also be made The "all plastics" felt is not here yet but its first cousin is And this material has all the highly desirable properties of the plastics It could, for example, be made resistant to chemicals which disintegrate or else hopelessly weaken natural fibers like wool and cotton By the use of nylon and high-tenacity rayon formulations it might be resistant to temperatures of over 400 degrees, Fahrenheit.

When fiber mixtures, hardnesses and thicknesses of felts, and other properties have been worked out, the felt may further be impregnated, laminated, proofed, sized, or coated for extensions of its utilities

Asphalt impregnation is a weather sealer when the felt is to be used for cowl seals on airplanes or for anti-squeak chassis strips on automobiles Bakelite improves the dielectric strengths of felts in electric motor washers, spacers, other electrical devices Graphite adds lubricity to felt anti-friction lubricating pads and to seals for bearings Chromate, natural rubber, synthetic rubber, petroleum products, natural and synthetic waxes, are other impregnations Resin emulsions add stiffness

FELT LAMINATES — Felt can be laminated with almost anything that can be held by cements Aluminum foil laminations with felt, for example, are used for insulation in light-reflectant, and acoustical and thermal insulating blankets Lead foil laminations are used as vapor seals in cold line pipe insulations Buna-S and Hycar are laminated with felt, as are various natural and treated woods and all of the common metals A hard or stiff felt can be laminated with a softer one An ever-increasing number of products are felt lined or clad

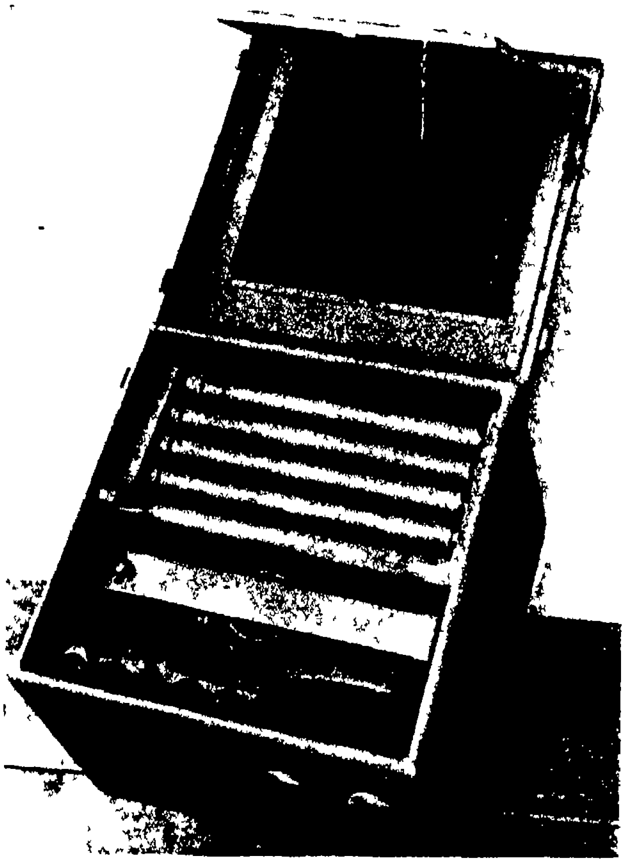
Chemical proofings can make felts resistant to flame for aircraft use, to flame and fungi for acoustical and thermal insulation, to fungi for use in the tropics Mildew, mold, moths, carpet beetles, vermin, flame, moisture, or water all can be resisted by felts which have been proofed against them

Sizings applied to felts can create any physical property from slight to high stiffness Latex sizing imparts a spring-like property, makes the felt stiff but flexible

Surface coatings are largely for adhesive backing The coated felt handles like a dry surface material for all ordinary purposes But when subjected to slight wettings with solvents or to the controlled application of heat, the surface becomes adhesive so that the felt will hold to surfaces pressed against it Automotive channels thus made will hold to the metal or other parts with which they are assembled Coated felt letters, heated and pressed into place, can be expected to hold their positions Rubber-coated felt weather stripping even is made pressure sensitive, needing neither solvents nor heat.

MANY FABRICATING METHODS — Once the felt has been made, it becomes a raw material for fabricating into end products And there probably is no other single type of material which runs the gamut of so many fabricating methods

Soft felts are handled much like any fabric Almost all felts may be machine cut to precise shapes or stripped to close dimensional tolerances But whereas the soft felts are die stamped with simple knives such as might be used on paper, the hard ones shear more like metals and must be handled accordingly And the harder felts may be set up in lathes or other machine tools and machined like hard woods



Two felt sheets offer excellent shock-protection to the spare lens housed in the lid of this emergency field-surgery floodlight unit

The felts which are heavily admixed with plastics fibers and, even more, the all-plastics felt-like materials, may be heat sealed—"electronicly stitched"—or formed to shape by the use of heated dies such as are ordinarily employed for the forming of thermoplastic sheets No single authority seems to know how many of the methods common to metals forming and to thermoplastic sheet and rod fabrication are being applied to these felts right this minute The use of synthetic fibers in felts dates back more than ten years, but in most of its phases it is so new that many of the product makers are keeping close guard over secret procedures learned by trial and error But more than one practitioner is rolling his felt products to finished shapes, even spinning them as sheet metals and plastics are spun on lathes

One of the primary properties of felt is multi-directional strength It is possible when making rolls of felts 30 to 40 yards long by 72 inches wide to obtain either balanced strength or some superiority of longitudinal strength over transverse strength. And in sheet felt which usually is made in one square yard dimensions there are almost no differences in directional strengths Since most roll felts are also

• LOOKING AHEAD •

All-plastics felt-like materials Felt and felt-like materials formulated with qualities "made to order" Further studies bringing new uses and markets Major improvements in the fine arts of grinding and polishing

made with balanced strengths, very little attention need be paid to the directions in which stresses will be applied to felts And in this felt differs from nearly all of the woven textiles, the woods, and the wrought metals

STRESSES ARE LOCAL — Another property of felt is that a compressive force applied to felt tends to result in strains which are concentrated in the direction of the stress A heavy load placed on a small area of a felt sheet tends to compress the felt immediately beneath the pressure and not to spread the felt sideways This is useful in that felt parts of machines do not tend to spread and bind against adjacent moving members, and in that the uncompressed and little strained areas of the felt retain their full capacities for noise and vibration dampening

By varying the admixed fibers and the treatments the wetting-out and hence the capillary action of felts can be varied widely and with close control Capillary action is important where felts are used to feed lubricants as in wick feed lubricators, or to apply or remove water and other fluids as in paper machine blankets

Because of the ability of hard felt to absorb and store polishing compounds while acting as a frictional surface, a felt surfaced lap or wheel can take scratches out of sheet glass by causing the glass to flow rather than by grinding it away Similar abilities to make the surfaces of thermoplastics flow under frictional heat can be useful as an industrial art Wool felts—and felts admixed with nylon and some of the other abrasion-resistant plastics—are highly embeddable to abrasive dusts and polishing compounds and can make major improvements in the fine arts of grinding and polishing

Felt, one of the simplest materials to make in its cruder forms, is one of the most complex to diversify The felt industry really is producing an entire family of materials, it is just as uninformative to say "felt" without adding a specification as to say "steel" without stating whether the steel is low carbon, high alloy, stainless, wrought, or cast

Felt types already are immensely diversified, closely standardized The study of them continues, and from it comes a continuous development of new and useful products Directly ahead are highly important markets And toward them felt is feeling its way

Almost all felts may be cut to accurate dimensions on precision machines

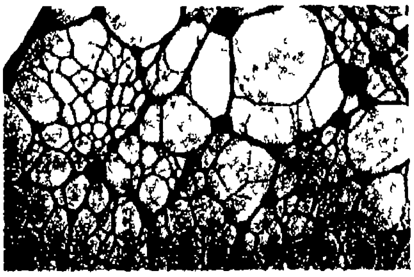
Elasticity Explained

Investigations With the Ultramicroscope Have Proved Visually that Elasticity is No Monopoly of Just a Few Substances Molecular Weight Distribution is Important and Realization of This Has Already Resulted in Improvement in the Elasticity of Synthetic Rubber

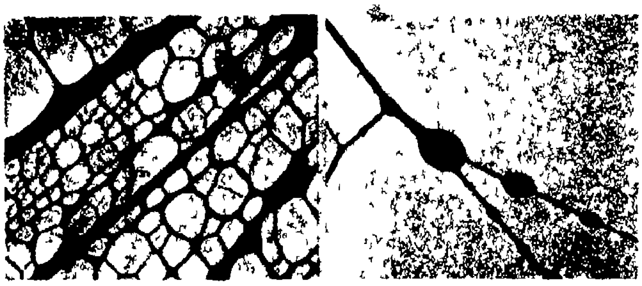
By
Ernst A. Hauser, Ph.D.
Associate Professor of Chemical Engineering
Massachusetts Institute of Technology
and
Desiree S. le Beau
Director of Research,
Midwest Rubber Reclaiming Company

THREE years ago the scientific world was startled by revelations made with the electron microscope in regard to the moleecular configurations of rubber To obtain such visual evidence, conditions had to be chosen so that the density differences of regions resolvable with the electron microscope (above 6 Angstroms—1 Angstrom equals 0 00000001 mm) are large enough to be observed Suitable specimens were made by spreading a thin film of rubber which had been dissolved in an organic solvent on water and then allowing the solvent to evaporate When the film is picked up over a 200 mesh wire screen it breaks into fibers and nodules which range in width from several microns down to 100 Angstroms The first specimens examined with this method in the electron microscope were prepared from benzene solutions of smoked sheet hevea rubber

In these preparations two distinct types of structures were found Figure 1 represents an electron photomicrograph of hevea rubber One can easily differentiate between slender fibers and numerous ellipsoidal nodules along their length The shape of the nodules is strongly suggestive of fluid regions, whereas the fine network structure indicates considerable rigidity To test this assumption, preparations of guayule rubber were made This natural rubber, although chemically identical in composition with hevea, differs from the latter in that it is composed of a much greater percentage of a low molecular weight fraction Figure 2 shows this visually To substantiate these findings even further, hevea rubber was subjected to fractionation into the so-called "sol" and "gel" fraction by virtue of its differential solubility in appropriate solvents Figure 3 was obtained from the low molecular weight, or sol, and Figure 4 from the high molecular weight, or gel, fraction



Left: Figure 1. Hevea rubber through the electron microscope



Below: Figure 2. Guayule rubber. Total (left), sol fraction (right)

SOME QUESTIONS NOT ANSWERED — As interesting and admittedly exciting as these findings were, they placed before the colloid rubber chemist several questions which begged for answers How are these nodules formed? Is this an instantaneous reaction? Has this apparent two-phase structure any bearing on the property of elasticity? Why do the strings or nodules not coalesce when they tear, as shown for example in certain parts of Figure 4 (see arrows)? To answer these questions satisfactorily, some other technique had to be worked out The electron microscope does not permit the study of the same preparation over a prolonged period electron microscopy calls for high vacuum and the preparation is exposed to electron bombardment and a resulting increase in temperatüre

Although the resolving power of the electron microscope is many times greater that that of the ordinary microscope, its limit lying close to 6 Angstroms, this extremely high power is not the predominant factor in an investigation such as that of the fundamentals of elasticity, as long as the shape or morphology of the preparation can be observed

Ultramicroscopy with incident light seemed to be a technique which might fulfill all requirements since the resolving power of the ultramicroscope using the most modern methods of illumination permits observation of discontinuities down to 20 Angstroms The preparations used in this study were made in exactly the same way as those for the electron microscope

The only instrument suitable for such work is the "Ultropak," developed by E. Leitz in Wetzlar, Germany It differs from other microscopes using incident light for illumination such as the metallurgical microscope (see Scientific American, page 25, July 1947) in the path taken by the rays of light used for the

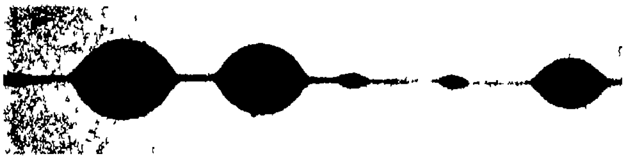


Figure 3. Hevea rubber, sol fraction

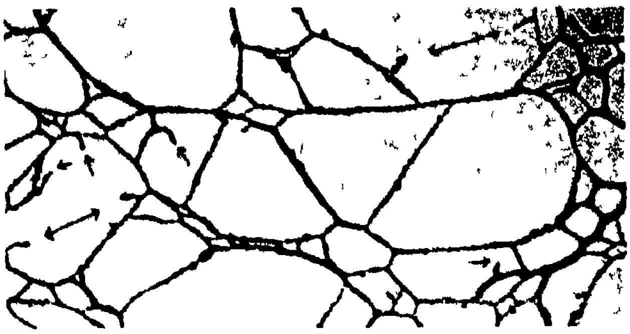


Figure 4. Hevea rubber, gel fraction

illumination of the specimen. As shown in Figure 5, the light is focused on the preparation through a lens ring surrounding the objective. This results in an ultramicroscopic type of illumination. Only light reflected from any discontinuity in the preparation is reflected through the objective of the microscope into the eyepiece or the photomicrographic apparatus.

FORMATION NOT INSTANTANEOUS — The first results clearly demonstrated the feasibility of this new technique. Enlarged and reversed prints (Figure 6, for example) give an effect directly comparable with the pictures made in the electron microscope. Very soon it was discovered that the formation of the globular nodules was not instantaneous, but rather a time-consuming reaction, and that their size was dependent on the ratio of low to high molecular weight fraction of the polymer under investigation (Figures 7 and 8).

The next step was to find an explanation for this phenomenon and to offer as much evidence for it as possible. Careful studies of the filaments with polarized light and facts known from X-ray investigations of rubber indicated that the high molecular weight fractions are composed of long chain-like molecules which aline if put under tension. When this happens, the low molecular weight fraction, composed of short chains, is squeezed out and forms the globular nodules. This phenomenon is known to the colloid chemist as synaeresis. Since this reaction is based on the movement of the molecules it should be possible to speed it up by raising the temperature.

A heatable substage was therefore constructed for the ultramicroscope and the same preparations studied at slightly elevated temperatures. The formation of the nodules which took 24 hours at 20 degrees, Centigrade, only took 15 minutes at 40 degrees, Centigrade (Figure 9).

Gutta-percha is chemically identical in its composition to natural rubber. X-ray studies have shown that the only difference between them is the location of the methyl group in the hydrocarbon molecule. If a preparation of gutta-percha is subjected to ultramicroscopic studies, one finds only very coarse filaments with ragged edges (Figure 10). If, however, this sample is heated to 65 degrees, Centigrade, the formation of fine threads and globular nodules immediately becomes apparent (Figure 11). At this temperature gutta-percha is elastic.

These are the facts, and now it is up to us to see if they are the long-missing pieces of the jig-saw puzzle entitled "elasticity." Before trying to put the picture together, we would like to quote from two old publications and offer more experimental facts.

IN OLD PAPERS — In a paper published in 1896 in the *Journal of the Franklin Institute*, Reginald Aubrey Fessenden says: "The elasticity of such substances as India rubber and gelatine was investigated. It was shown that such substances consist of two or more compounds interpenetrating but not combining with one another."

In a paper by Paul Bary and Ernst A. Hauser (*Kautschuk*, May 1928) on the structure of rubber, one finds the following statement: "Bary's theory that rubber consists of two components which under normal conditions are intersoluble, is in accord with results obtained from X-ray investigations. The observation that elongation of rubber causes a separation of the dissolved part and the solvent (theory of Hauser and Mark) leads to the assumption that rubber is composed of a network which will give rise to X-ray interference spots if, by putting it under tension, the lower molecular weight fraction is squeezed out, thereby increasing the coherence and alinement of the long molecular chains."

The colloid rubber chemist knows also that the

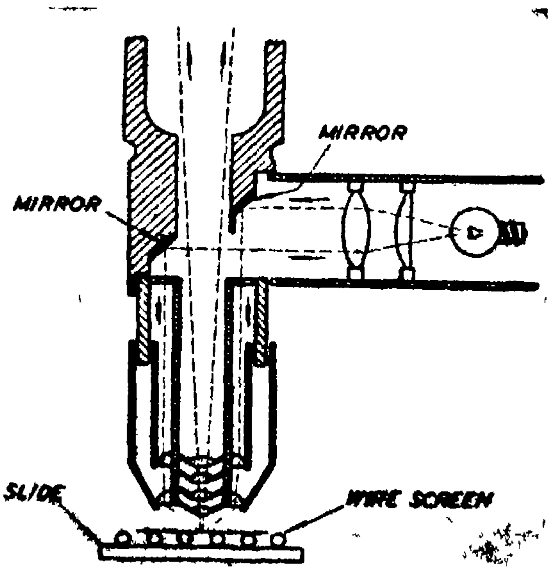


Figure 5. Diagramatic sketch of "Ultrapak" ultramicroscope

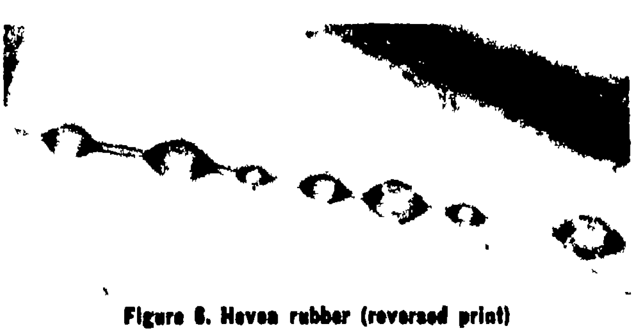


Figure 6. Hevea rubber (reversed print)

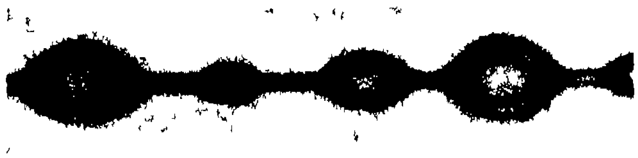


Figure 7. Guayule rubber

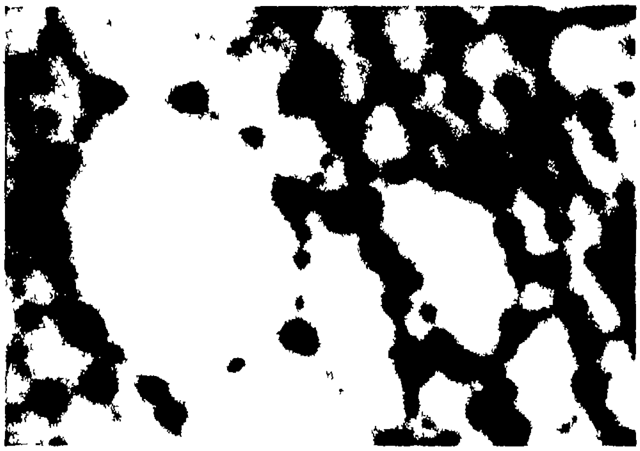


Figure 8. Cryptostegia rubber

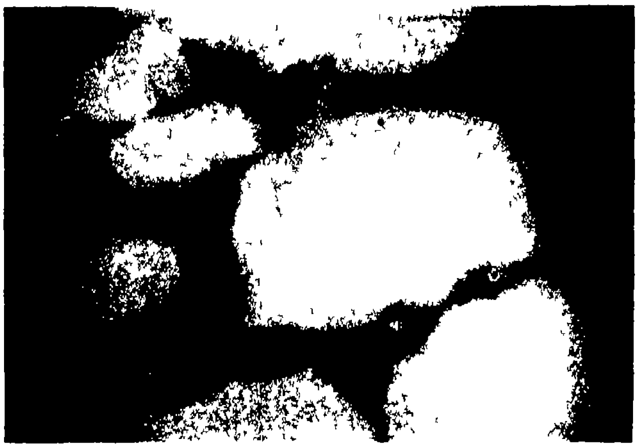


Figure 10. Gutta percha

low molecular weight fractions of natural rubber are a sticky substance, the highest molecular weight fractions are a hard substance, both fractions are lacking in elasticity And it is known too that this property of elasticity is a function of the molecular weight distribution present in natural rubber

If we now place all these pieces of information together, the picture is complete Contrary to some admittedly ingenious theories which have been postulated, elasticity is not the monopoly of matter composed only of snarled-up long molecules comparable in their structure to a wire spring, but is the result of a specific molecular weight distribution of the same chemical compound, or the dispersion of a lyocratic colloid in a solvent

Fessenden's and Bary and Hauser's multiphase theories have now found the visual proof they were still lacking This is admittedly a very straightforward statement and since the conclusions which can be drawn therefrom may have far reaching consequences of scientific and industrial importance, it seems only fair to at least attempt to offer further proof for its validity

ADDITIONAL EVIDENCE — Polyisobutylene is a fully saturated hydrocarbon and therefore much less reactive than rubber The lowest polymers are clear, free flowing liquids, the polymers of medium molecular weight are sticky masses, and the high molecular weight polymers are hard and brittle Films deposited on a screen from the former collapse completely upon evaporation of the solvent The high molecular weight fractions only yield bands Mixtures of the two, however, result in filaments studded with nodules Such a polyphase system also exhibits pronounced elasticity

The elastic property of the copolymer of isobutylene and butadiene or isoprene, known as butyl rubber, as well as of the butadiene-styrene copolymer known as Buna S or GR-S, has also been considerably improved since the importance of molecular weight distribution has been taken more into account

The new ultramicroscopic technique has not only offered the first visual proof that elasticity is primarily the property of multiphase systems, but has thereby discredited the idea that elasticity is a property monopolized by only a few substances The field is wide open and new developments in the synthesis of elastic matter can therefore be expected from now on at an increasing rate

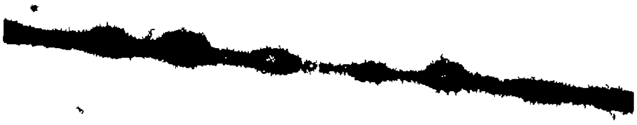


Figure 11. Gutta-percha at 65 degrees, Centigrade

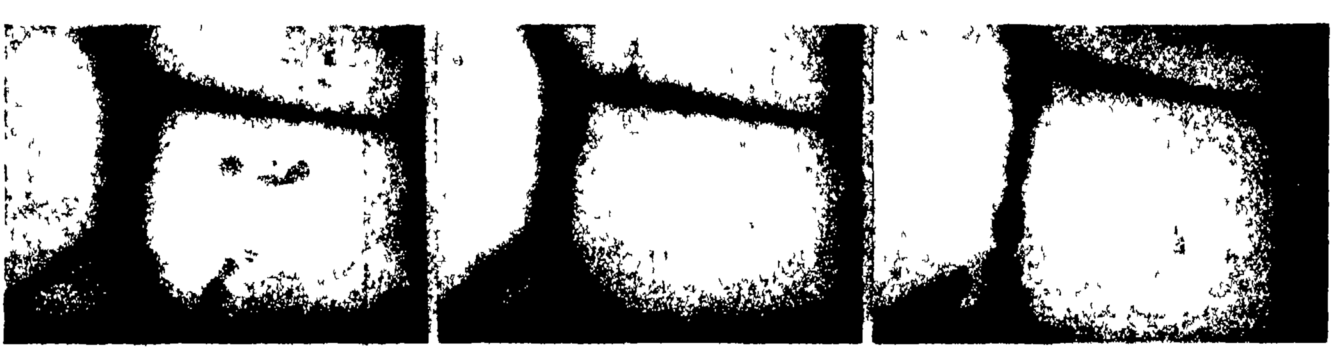


Figure 9. Cryptostegia rubber at 40 degrees, Centigrade. Left, at 0 minutes; Center, 7 minutes; Right, 15 minutes

Putting PLASTICS In Its Place

By
The Technical Service and Design Staff of Ross-Frederick Corporation

Misapplication of Plastics During Recent Years Has Led to a Long Procession of Wholly Unsatisfactory Products, With a Noticeable Loss of Faith in Plastics by Consumers as a Result This Can Be Corrected Only by Applying Sound Engineering Practices to Plastics Fabrication — By Assuring Right Plastics for the Right Job

THE MISUSE and abuse of plastics in consumer products have long been a serious headache to sales managers and customers Many new items designed for consumer use have been unable to withstand normal usage, either they were poorly designed or the plastics chosen was incapable of performing its assigned function Even when the proper plastics was chosen, the amount of material employed was often too skimpy to transform the basic concept into a useful and durable object

War-time shortages of metal and wood increased the demand for plastics items, but too often the consumer learned, to his or her expensive sorrow, that the rush to exploit this market produced little but shoddy merchandise The public naturally resents purchasing plastics products which became valueless after one or two applications, and the industry as a whole is injured when consumers lose faith in plastics

To give plastics their proper places as fabricating materials, a program has been laid out for applying sound engineering and research principles and practices to consumer-goods design and fabrication Main objective of this program is to use the right plastics for the right job and to use other material if a plastics cannot be found which will fulfill all requirements Work along these lines is resulting in an entirely new concept of the ways in which plastics can be applied

All photos courtesy Ross Frederick Corporation

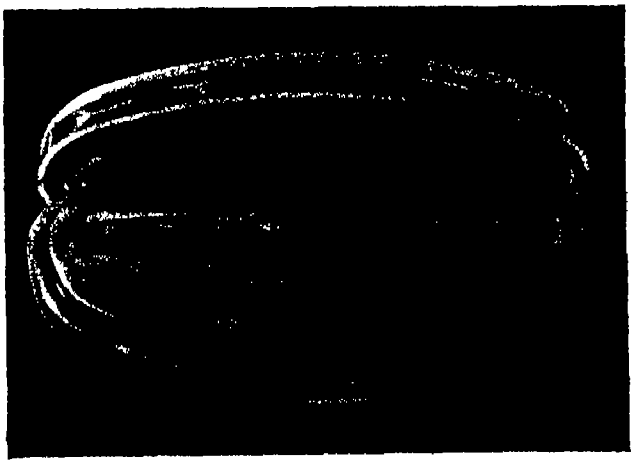
Polystyrene canisters are easily cleaned, light weight, and rugged

ENGINEERED TABLE LAMPS — A brief review of some of the consumer goods that have been produced by adhering to these principles will point up the success of the program thus far For example, in a series of modern table lamps designed to take full advantage of the decorative and structural properties of various plastics, it is at once apparent that one of the design fundamentals has been the use of sufficient material where it will give the desired strength and beauty, there has been no stinting of material, no use of scrap or surplus stocks Rather, the idea was to design toward a desired effect and to procure plastics material for that given effect

Thus acrylic may be used with molded phenolic, with wood laminates, with rods made from phenolic-impregnated linen—each material adding its own special quality Color and brilliance, for example, are contributed by the acrylics It is the light-transmitting quality of this plastics that gives the effect so desired in lamps intended for the living room and bedroom And by making bases of wood laminates and molded phenolics, they can withstand the knocks and scratches which will almost inevitably befall them

Varying the materials not only insures beauty and durability, but makes possible the keying of a lamp to a particular color scheme Then, too, the apparent weight or mass of a lamp can be affected by the wise selection of plastics materials Thus, a library lamp might well use a preponderance of laminated tubing in the darker wood colorings, or deep-toned sections of acrylic stock This would contrast with

Methyl methacrylate was chosen for this pencil barrel for its durability and weather resistance



slender spires or diamond-cut disks of clear acrylic fashioned into boudoir lights The effects that have been achieved in these lamps were made possible through the imaginative and generous use of plastics materials In one lamp, for example, use is made of the light-carrying properties of methyl methacrylate in the light and dark toned amber rods that make up the body of the lamp The sweeping curve of the rod assembly serves the double purpose of insuring a balanced appearance regardless of the angle from which the lamp is viewed, and of increasing the sparkle of the lamp body by presenting more and varied surfaces to the rays of light.

The same basic design has been employed in a number of other lamps In one case, the rods are made of phenolic-impregnated rolled linen tipped at both ends with clear acrylic As with the other lamps of this same construction, the base is of laminated wood, a material which has been found to withstand the wear usually meted out to lamp bases, at the same time blending with the overall color scheme

A modification of this stacked or tiered design is employed in another lamp Rods have been replaced with flat sections of methyl methacrylate tapered at the edges so that the lamp standard brings to mind the curved roof of a Chinese pagoda. No attempt has been made to camouflage the center tube through which the wiring is strung Rather, it has been thought to enhance the design by interrupting the pattern which has been set by the clear plastic sheets

Entirely different is another design Here, vertical rods are the motif—in this case, alternating rods of clear acrylic and laminated tubing made from phenolic-impregnated rolled linen By substituting clear acrylic for the laminated tubes, an entirely different effect is created Or smaller clear plastic rods may be set around a large center rod of acrylic or an opaque material

Holding these rods in position at top and bottom are solid sections of molded phenolic A wood laminate, however, serves as well, and disks of acrylic have been used in some models

WITHOUT ADHESIVES — An unusual feature of these lamps is their lack of internal binding No glue or other adhesive is used to hold the lamps together Instead, each piece is fabricated (cut and machined from sheet stock) to tolerances as close as 0 0005 inch These close fitting pieces are then mounted, one above the other, on the metal tube holding the wiring Pressure is applied from the top finial to complete the assembly and to form a sturdy, decorative lamp This pressure is sufficient to bind the lamps tightly together and prevent slippage of the individual pieces.

Another item to which sound plastics engineering practices have been applied, is a four-piece canister set for storage of flour, sugar, coffee, and tea

In developing this kitchen aid, the primary consideration was to protect, yet not contaminate, the contents A maximum of safety had to be achieved to protect users In addition, the set had to be attractive, sturdy, light-weight, reasonably priced, and easy to clean with soap and water. Although plastics have been used in other household ware, this was one of the first applications where plastics would be in continuous contact with foods over long periods

From the 22,000 plastics formulas available to plastics manufacturers, one had to be chosen which would meet the consumer needs and at the same time would be adaptable to certain manufacturing essentials The material had to be available in various colors, available in sufficient quantities for mass production, and easy to handle in the manufacturing process

Polystyrene was the plastics selected It had all the consumer requirements and, since it was basically colorless, could be colored to suit any need Low water absorption would prevent moisture from the canisters and ruining the food Also, there was no objectionable odor which could be passed on to the contents It had good die finish, eliminating tedious hand finishing after initial manufacture Its inherent luster lasts for years without waxing or polishing Developed before the war, polystyrene had undergone severe war-time usage, and was known as a rugged material

The characteristics of polystyrene indicated that injection molding would be the best method of manufacture The round shape of the canisters was adopted because women prefer this conventional form. It is easier to clean with soap and water, and there are no sharp corners to tear clothing Also, granular foods flow easier from this shape The bottom was niched to provide additional strength—arch construction being one of the strongest of the basic design concepts—and so the container would sit flat without bulging

The clear polystyrene tops provide an instant view of the interior To insure a close-fitting, dust-pro-

Sound engineering and good taste combined to produce this table lamp. Vertical rods of clear acrylic are alternated with rods of phenolic-impregnated linen

• LOOKING AHEAD •

Full realization by the public of the capabilities and limitations of plastics Plastics products which live up to consumer expectations Plastics invading many new territories from which public prejudice has long barred it Plastics losing the stigma of "substitute material"

tecting cover, the tops are ridged around the edges These ridges grip the canister tightly—so tightly, in fact, that a vacuum pull is felt when the top is lifted A finger grip, molded as part of the top, completes the cover

SIX-COLOR MECHANICAL PENCIL — The production of a six-color mechanical pencil presented new problems A sturdy case, but little larger than an ordinary pencil, had to be designed to hold the mechanism and colored leads Although six different leads are contained within the barrel, it was felt that the size should be as close to an ordinary mechanical pencil as possible The case had to withstand weathering, as many of the users would be construction engineers and others engaged in outdoor projects A durable finish, to increase the sales appeal, was necessary The weight of the case was important, too, since a heavy, bulky barrel would decrease its effectiveness as a handy tool. Finally, the material had to have good dimensional stability, to withstand extreme changes in temperature, and not be brittle

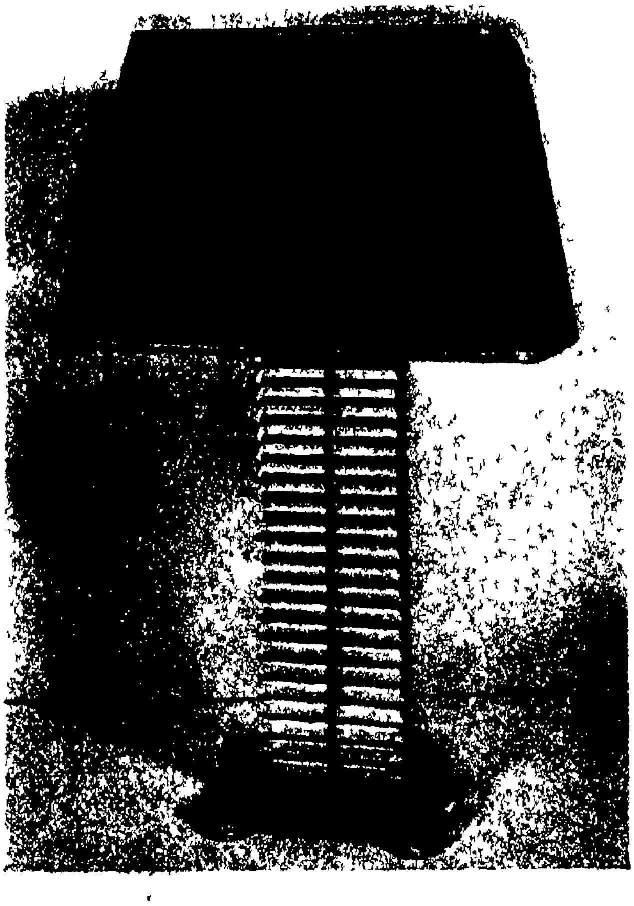
Methyl methacrylate was the material chosen Noted for its clear transparency, it was also available in many colors, both transparent and opaque Light grey was the final selection as it is a neutral color, and will not readily show wear and tear

Again, injection molding was used because of the material's characteristics After molding, each barrel is finished by hand and the final assembly, including mechanism and leads, is performed by hand.

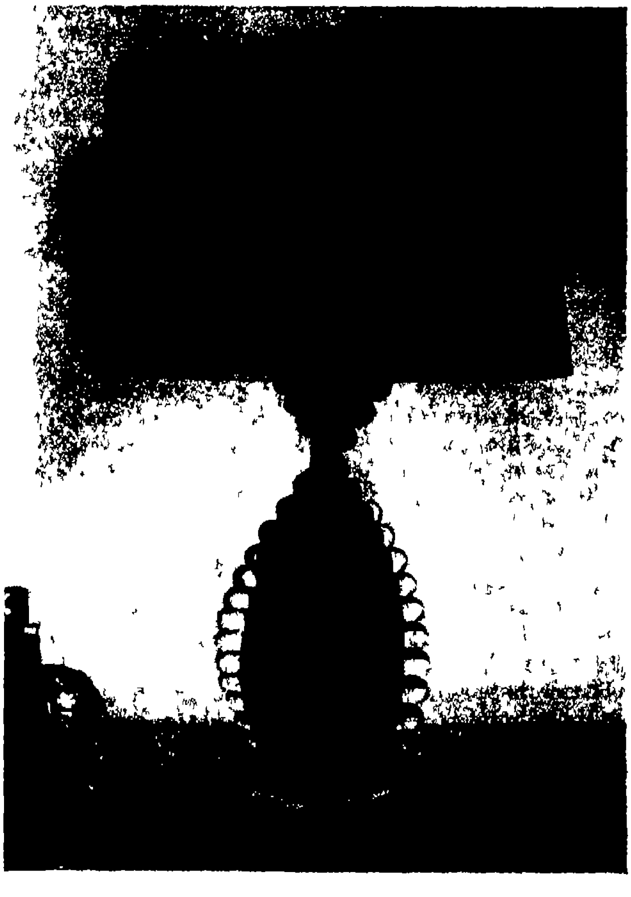
The finished pencil is a combination of methyl methacrylate and chrome plated brass The mechanism is all brass, since it was felt that no plastics could perform the function properly Brass bands reinforce the point, center, and head of the barrel while the clip, which is also the color selector, is formed from the same metal Thus the best qualities of two different materials are combined to create a useful writing tool

The fields for plastics merchandise are only now beginning to be appreciated In the future, careful engineering of the thousands of available plastics materials will provide a host of products to benefit both industrial users and home consumers, and to bring about the recognition of plastics for their own special properties and not as temporary substitutes

Suggestive of a Chinese pagoda, the tapered sections are of clear methyl methacrylate



Phenolic impregnated linen rods tipped with clear acrylic make a sturdy, unusual lamp stand



CO-OPERATION HITS Corrosion

Competitors Working Hand in Hand Are Carrying on Extensive Studies Aimed at Breaking Through the Barrier of Question Marks Which Surrounds the Corrosion Characteristics of Metals Information Thus Gained is Aiding the Co-Operating Manufacturers to Turn Out Better Products More Economically

By T. C. Du Mond

Managing Editor, MATERIALS & METHODS

CORROSION, in effect, is the cancer which destroys metals Starting as a tiny, perhaps invisible spot, corrosion steadily eats its way through the very heart of the metal on which it is working until, for all practical purposes, the metal dies Indeed, when corrosion has worked long enough on certain metals those metals actually fall apart And just as cancer attracts the attention of medical scientists throughout the world, a small army of metallurgists, engineers, and researchers is devoting its efforts to learning how corrosion works and what can be done to prevent it, or to slow its destructive action

Although the problem of corrosion has been faced for many years, it has not been until recently that much progress has been made in understanding the whys and wherefors of rust We know that mere protective coatings are not sufficient to prevent corrosion for anything more than a relatively short period When and where coatings are retained intact, corrosion in inhibited, but once these surfaces are broken by so much as a microscopic hole, the action starts and rust begins to form

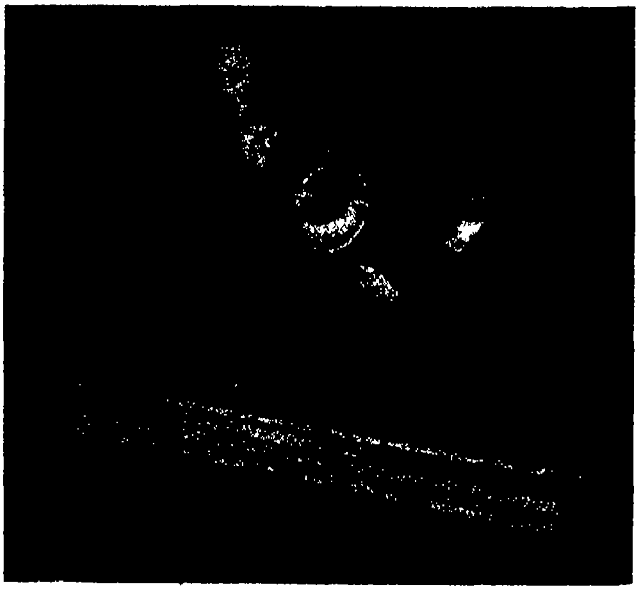
Except for the so-called noble metals—gold, silver, platinum, and the like—all metals are affected to some extent by corrosion. However, on some metals such as aluminum the corrosion product is a tightly adhering oxide film that serves to protect the metal under it Other metals are not so fortunate

The greatest problem in learning about corrosion lies in the fact that corrosion's causes and effects, vary with most metals Since iron and steel are the most common and least expensive of engineering metals, most of the study now being conducted centers about them.

Some metals tend to oxidize in any atmosphere, but most others are relatively stable unless the atmosphere is moist or contains salt, sulfur, or acid fumes and other harmful impurities Thus, while a material might last for long periods in some dry midwestern area, that same material might disintegrate in a very short period in such a locality as Kearny, New Jersey, where the atmosphere is not only salt-laden from the ocean but also carries all types of corrosive industrial fumes Since it is seldom known where a product will eventually be used, manufacturers must select materials that will survive in all but the worst extremes of climate

CO-OPERATIVE TESTS RUN — Typical of the extensiveness of corrosion studies being carried out by industry are those run at the test station at Kure Beach, North Carolina This station is maintained jointly by the International Nickel Company and the Magnesium Division of Dow Chemical Company Other active co-operators in the project are Carnegie-Illinois Steel Corporation, American Rolling Mill Company, and Union Carbide and Carbon Company Producers of many materials other than metals send their products here to be tested to learn how marine atmospheres affect them At this particular test station more than 15,000 specimens of various metals and alloys are exposed to marine atmospheres, while another 2000 pieces are immersed in sea water

The Permat piano action, made of magnesium, plastics, and other water-resistant materials, is said to withstand destructive humidity



Most compositions to be tested are represented by 16 samples Two specimens of each are removed after exposure for six months, two more after 18 months, and four more after 42 months After 7½ years four more specimens will be taken in for study, and the remaining pieces will continue to be exposed for a full fifteen year period

When specimens are taken off the test racks, they are studied to see the visible effects of exposure After their appearance has been noted, the samples are cleaned and then weighed and measured to determine the weight-loss through rust, and to learn the rate of corrosion penetration Finally, the specimens are given physical tests to determine changes in tensile strength

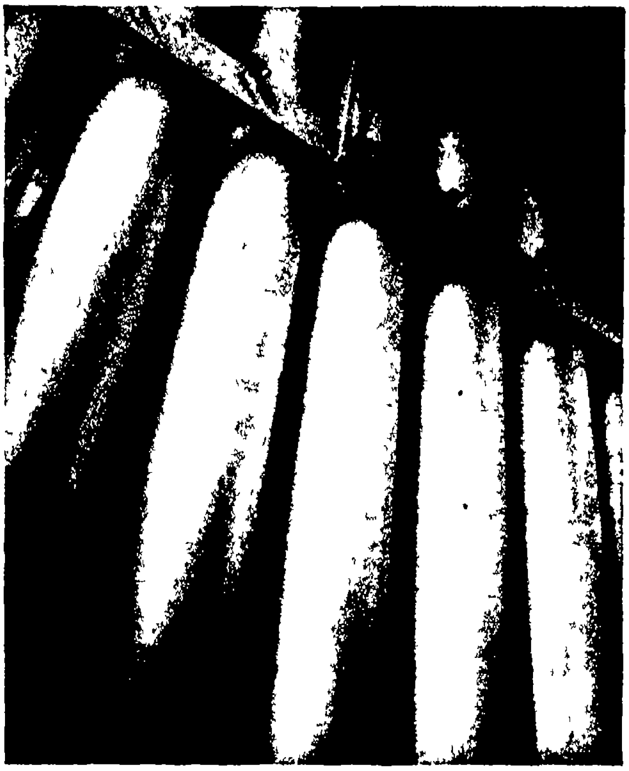
Although most of the knowledge gained through corrosion studies is primarily of interest to corrosion engineers, considerable information of immediate interest to the consuming public has been unearthed For instance, it is now possible to estimate, after six month's exposure, how long a steel or iron can survive in the atmosphere to which it is exposed The studies show that corrosion-resistant metals and alloys corrode rapidly for the first few weeks of exposure and after that period rusting takes place very slowly Major changes in color and weight occur in the early months and many samples appear to be much the same after exposure for six years as they did after only six months

VARIATIONS IN STAINLESS — As might be expected, the stainless steels show corrosion resistance superior to other steels, but there is considerable variance within the stainless group Those stainless steels having more than 14 percent chromium stain rather than rust Several grades show remarkably little staining and pitting even after exposure to salt air for considerable periods Types 310 (25 percent nickel, 20 percent chromium) and 316 (16 percent chromium, 12 percent nickel, and 2 percent molybdenum) are the most resistant Nitriding of stainless steels seems to reduce their resistance to corrosion

Copper appears to be the most powerful element for improving the corrosion resistance of steels, especially when used in small quantities Ordinary steels are helped immensely by the addition of about 0 05 percent copper Little further improvement comes from increasing the copper content unless the copper is combined with some other element such as nickel Among the other principal alloying elements the following effects are noted Manganese, slightly beneficial, silicon, strongly favorable in conjunction with other elements, nickel, uniformly beneficial effect roughly proportional to the nickel content, chromium, similar to nickel, with those steels having 13 percent or more of chromium showing practically no weight loss through corrosion

Results of the tests show that the position in which the iron or steel is used has considerable bearing on how fast it corrodes. While most of the damp atmospheres would be expected to condense on the top surfaces of exposed metals, most of the rusting on the test pieces at Kure Beach took place on the under surfaces at roughly a 60/40 ratio The action of rain and sun in washing and drying the top surfaces apparently slows corrosive action on such surfaces

In addition to bare metal samples, exposed specimens include those protected with a variety of coatings, both metallic and non-metallic For steel, aluminum varnishes and zinc-dust paints seem to be most satisfactory Vinyl coatings are standing up better than phenolics A new type of metal combination—aluminum dip-coated steel—produced by hot-dipping steel strip and sheet gives promise of highly satisfactory service life However, the tests seem to indicate that the most economical and long-lived method of coating steel is still galvanizing The only really satisfactory metal-spray coatings appear to be aluminum, zinc, and lead


Strong, clean, non-corrosive stainless steel is ideal for use in these nitrogen and argon gas tanks at Westinghouse's lamp manufacturing plant

Tests at Kure Beach have done much to prove the contention of magnesium producers that magnesium alloys, properly used, present no corrosion problem Test specimens exposed for many years on racks only 80 feet from the Atlantic Ocean are still in satisfactory condition Magnesium samples include rolled, extruded, and die-cast alloys Bare samples as well as those with various coatings are on the test racks Most of the magnesium alloys have resisted heavy salt atmosphere attacks with only minor surface pitting and etching

BOLTED, RIVETED JOINTS — Since most of the corrosion problems in connection with the use of magnesium alloys are due to galvanic action, tests are carried on with various joints and bolted and riveted assemblies Because the working characteristics of magnesium alloys are such that they cannot be used for rivets, various aluminum alloys have been tried Both service tests and tests such as these at Kure Beach prove that 56S aluminum rivets are most suited to use with magnesium and thus are universally recommended, replacing the 17S aluminum

With non-corroding aluminum used in such engines, railroads are able to achieve light-weight construction, reduced maintenance, and a lasting bright appearance

• LOOKING AHEAD •

Chromium plate resisting rust-spotting even after prolonged exposure to moisture Plumbing which lasts a life-time . Understanding of corrosion enabling the selection of the most suitable metals for the job More effective corrosion preventives . Corrosion ceasing to be a major problem.

alloy rivets formerly used When bolted assemblies are required and are to be used in damp, corrosive atmospheres, cadmium-plated steel bolts are satisfactory if 52S aluminum alloy washers are used as insulation. Stress-corrosion cracking in welded magnesium-alloy structures can be avoided by stress-relieving treatments, consequently such treatments are now advised for all magnesium welds

Several copper alloys are being tested both in salt atmospheres and in sea water Outstanding observations thus far indicate that the tin in Navy "G" bronze can be replaced by nickel without significant loss of either corrosion resistance or mechanical properties, and that pure copper resists action of still sea water better than it does fast moving sea water (The opposite result was noted with Types 310 and 316 stainless steel)

Knowledge gained by such studies as those at Kure Beach has led to development of a cupro-nickel which contains only 10 percent of nickel, instead of the usual 20 percent, plus 0 8 percent iron This material is as low in cost as naval brass and has the added advantage of not being subject to dezincification For condenser tube service this newly developed material is fully as satisfactory as the traditional 80/20 cupro-nickel.

Such research as has been described is already resulting in metal products that will survive everyday usage much longer than was formerly possible

Here are some of the things resulting from such research automotive bright-work, such as bumpers and decorative strip, can now be plated with the correct type and thickness of plating to prevent it from being marred by rust spots after only one or two years of service Those who are driving pre-war automobiles can appreciate what this will mean Those searching for extremely long-lasting metal window screening material can have it now through an alloy of stainless steel and molybdenum, outdoor lighting reflectors, searchlights, and metal mirrors can now be made to retain their brightness and reflectivity for many years with little or no care, home plumbing that can withstand a lifetime of service is now possible Although these materials are now actualities, their cost is such that they may not be widely used for some time, but investigation is continuing to either produce the materials more economically or extend their uses so that volume production will bring the cost down

Industry can save untold thousands of dollars every year by selecting those materials which provide highest corrosion resistance per dollar of material cost Although stainless steel and special alloys are best in the matter of corrosion resistance, they might be too expensive to apply generally Thus, through test data, the so-called high-strength, low-alloy steels might be shown to be quite adequate The railroads have found this latter group of steels highly satisfactory for such uses as hopper cars, since they combine their anti-rusting qualities with high strength characteristics to provide greater pay-load capacities

The Kure Beach project serves to demonstrate how producers of competitive materials can co-operate for their common good Here competitors work hand in hand to learn more about corrosion so that all of their materials will be applied in the best possible way

To provide sure protection against corrosion, grilles of some makes of automobiles are capped with stainless steel, which is then further protected by chromium plating

ELECTRONS GUIDE THE CUTTING TORCH

A Photoelectric Tracer, "Reading" Directly From an Inexpensive Drawing, Controls the Oxyacetylene Torch to Cut From Any Pattern

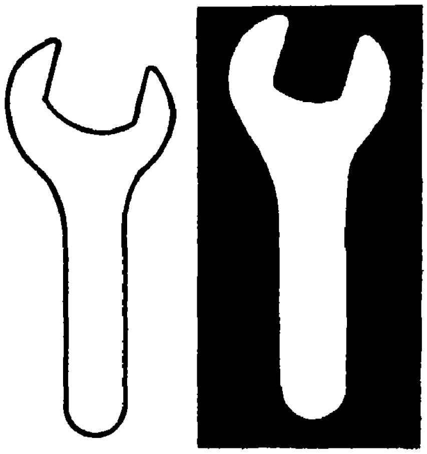
By T. H. Ayling
Technical Sales Division
Air Reduction Sales Company

ELECTRONICS, whose application to countless industrial processes has spelled higher production, greater accuracy, and greater safety, has now entered the field of oxygen torch cutting, making possible human-eye versatility combined with mechanical precision A photoelectric tracer which "reads" from a template drawing, controls the cutting torch through a pantograph, faithfully reproducing the original pattern

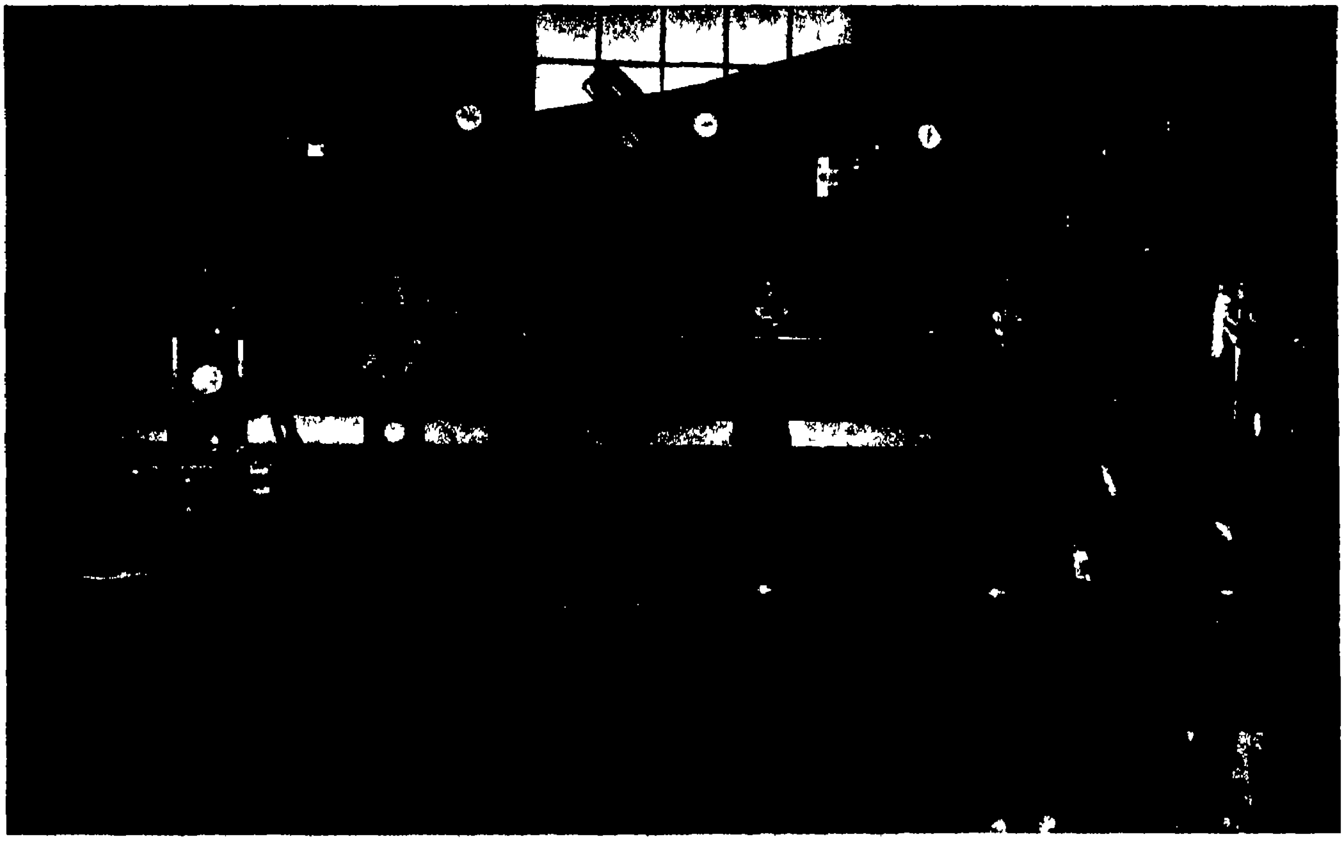
The oxyacetylene cutting torch was originally guided by hand, but over a period of years the torch itself has been so improved and refined that it has become far more reliable and accurate than the hand which controls it.

To take full advantage of the accuracy of which the cutting torch is now capable, machines have been developed in which the torch is guided by a precision-made track to cut straight lines Or a radius rod can serve as a guide if precise arcs or circles are to be cut

For simple irregular shapes, torches are mounted on pantographs By means of the pantograph, the torch is made to follow a path identical to that of a



Torches, mounted on a pantograph, are guided by an electronic tracer (below) that "reads" from a template drawing. The template may be either a line drawing or a silhouette (right)



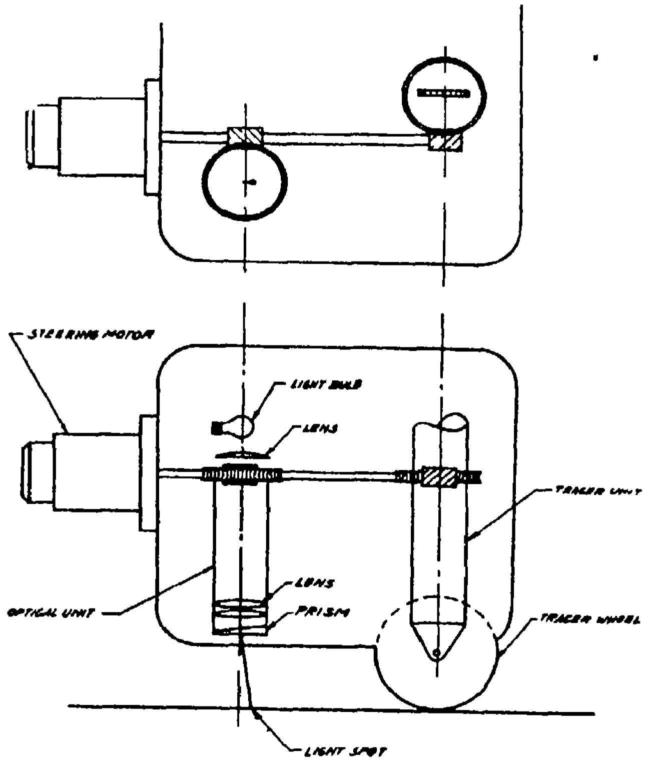
tracing mechanism as it moves along the line of a drawing, or follows the contours of a solid template When drawings are used as guiding templates, tracing can be accomplished by a wheel which rides on the drawing and is directed over the lines by hand When greater cutting accuracy is required than can be obtained by the human hand, solid templates can be made and the tracing device designed to follow the template contours through appropriate followers One common type of template tracer uses a steel template followed by a magnetic spindle The magnetized spindle clings to the template surface and is rotated to drive it along the template face

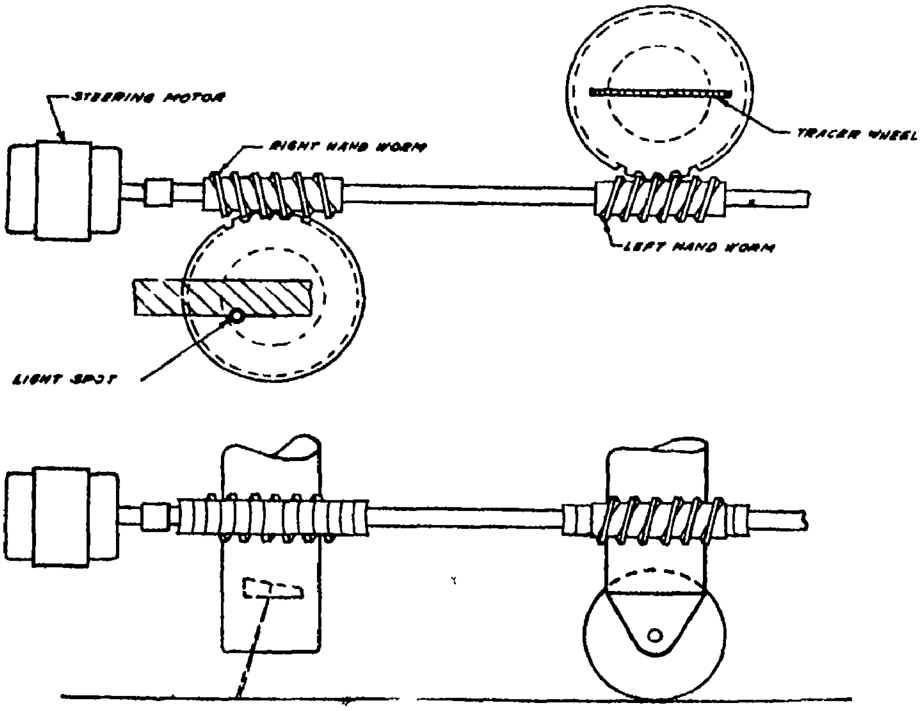
For the reproduction of complicated shapes, however, template design often presents considerable difficulty Close-tolerance cutting demands that the guiding surfaces be accurately machined Designing and producing steel templates for oxyacetylene cutting is often expensive and time-consuming work When only one or just a few shapes are to be cut, the savings in cost which are made possible by the cutting method itself can be more than eaten up by the cost of the template Even when template cost is negligible because of the quantity of reproductions to be made, a shop can spend a great deal of money for them over a period of time And what is perhaps more important there are contours for which it is impractical to make steel templates

The electronic tracer has greatly widened the practical field of machine gas cutting, not only by greatly simplifying the template problem, but by extending the limits to include work for which it is impractical or impossible to manufacture proper steel templates

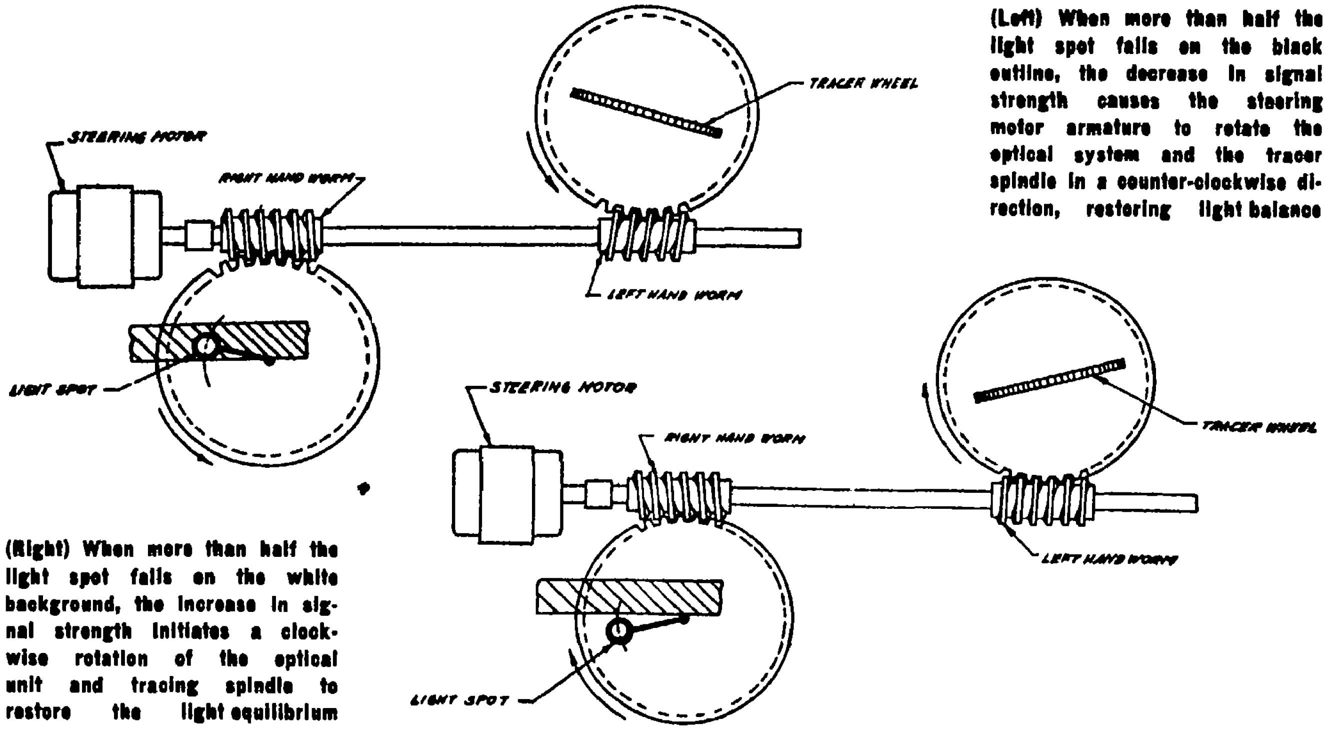
PHOTOTUBE GUIDES PANTOGRAPH — A tracer for oxyacetylene cutting performs two functions It controls the speed of the cutting torch, and it directs torch movement With the electronic tracer, the speed is controlled in the same way as it is controlled with the hand-guided tracer, namely, by adjustment of the speed of a motor which operates a driving wheel The direction of the motion is controlled by photoelectric tubes which "read" a drawing or a silhouette to guide the pantograph

To "read" the drawing, the photoelectric system picks up reflected light from a light spot which is directed onto the drawing Using this reflected light, the electronic system directs the light spot to follow the outlines of the drawing, and thus directs the tracer around the contour of the template





Schematic drawing (above) shows arrangement of optical system, tracer spindle, steering motor, and worm gear drive in tracing head. Note that light is deflected approximately 3/32 inch from center of optical unit. Sketch (left) shows operation of tracing head when following straight line. With the light spot centered half on white and half on dark background, no rotation of the steering motor armature takes place



(Left) When more than half the light spot falls on the black outline, the decrease in signal strength causes the steering motor armature to rotate the optical system and the tracer spindle in a counter-clockwise direction, restoring light balance

(Right) When more than half the light spot falls on the white background, the increase in signal strength initiates a clockwise rotation of the optical unit and tracing spindle to restore the light equilibrium

• LOOKING AHEAD •

Expensive, time-consuming machined templates eliminated Range of shapes economically possible by oxyacetylene cutting greatly broadened

The actual steering is done by a steering motor which operates to change the direction of the driving wheel's progress The action of this motor is governed by the photoelectric system whose operation is directed by the intensity of light which it receives When the light-intensity received becomes less, the system acts to operate the motor to steer the driving wheel and move the tracer in one direction—say, to the right When the intensity becomes greater, the system will operate the motor to steer the tracer in the opposite direction—say, to the left When the intensity of the light received by the photoelectric system reaches the point at which the system is in balance, the mechanism is inactive, the motor is inoperative, and the tracer will continue moving in one direction until the light-intensity is again changed

If the surface from which the light is reflected is dark-colored, comparatively little light will be reflected Much more light will be returned by a light-colored surface Thus, if the spot of light from the tracer falls partly on a dark surface and partly on a light surface, the intensity of the reflected light can be varied by shifting the spot to fall more on the dark or more on the light surface The operation of the electronic tracer is the continuous positioning of its projected light spot on the intersection of dark and light areas so that the intensity of the reflected light will be such as to balance the photoelectric system

When the light spot is directed onto the line of a drawing or onto the edge of a silhouette whose color is in contrast to the background, the electronic system will act continuously to position the light spot partly on the outline and partly on the background, seeking to adjust the intensity of received light to balance the photoelectric system This continuous searching of the electric eye for the contours or lines of the pattern beneath it enables the tracer to follow easily prepared drawings or silhouette templates

INEXPENSIVE TEMPLATE PATTERNS — The template drawing may be a blueprint or a tracing or an original drawing or it may be a simple solid outline on a background of contrasting color In any case, the pattern can be quickly and cheaply prepared and may be easily filed in a small space for future reference

The light which actuates the electronic system originates in a lamp in the tracer itself It is directed onto the template-drawing on a tracing table under the tracer, and is reflected to the photoelectric system

The lamp sends its light through an optical system which is mounted so that it is free to rotate about a vertical axis, and it is so designed that the light is directed from it at an angle The spot of light which is projected on to the tracing table is thus free to "search" in a circle The optical system is geared directly to the steering motor on the same shaft which steers the driving wheel

The electronic tracer can work to very close tolerances and, through its use, shapes can be reproduced by oxyacetylene cutting for which steel templates might be very costly or practically impossible to make

BAKING UNDER THE MICROSCOPE

Taken Through the Microscope, a Full Color Motion Picture of a Paper-Thin Cake Being Baked in a Miniature Oven Reveals Secrets Which Spell the Difference Between Baking Success or Failure

By Sara H. Carleton

FEW INDEED are the industries which have been left untouched by the camera and the microscope These instruments, combined in photomicroscopy, have made possible better products and fuller understanding of their true natures in nearly every branch of industry And the field of baking is no exception

Through cinema photomicroscopy and an ingenious process dubbed "micro-baking," knowledge of the manner in which the various ingredients of a batter combine during baking is being gathered, which should ultimately make possible higher quality baked products, and remove the elements of chance and guesswork from both commercial and domestic baking

A full-color motion picture, taken through a microscope, of a paper-thin cake being baked in an oven of Lilliputian dimensions, has recorded heretofore unknown facts which explain what factors determine the desirable and undesirable qualities of a cake The film offers the key to consistently successful baking

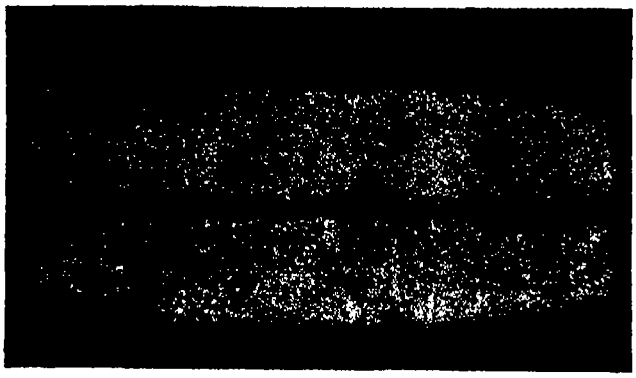
Micro-baking represents the first attempt to study scientifically the functions of the basic materials used in baking a cake So far, the work has no more than got off to a good start How long it will be before these investigations will pay off in faultless baked products of increased nutritive value is a matter of speculation It will depend largely upon the rapidity with which manufacturers fall into line, and carry on further investigation of a similar nature Photographing the actual baking process is only one aspect of the possibilities for future scientific study A separate analysis of each ingredient that goes into a bakery product and what happens to it under varying conditions is required in order to learn how to improve each product accordingly

The cake-baking movie film has already been shown at bakers conventions, to women's clubs and homemakers groups, and has been used extensively in the home economics departments of a number of colleges Hunter College in New York has run it a half dozen times

INCENTIVE FOR FURTHER STUDY — While the results of the first experimental film are not yet conclusive, and while they are important only in so far as they serve as an incentive for large baking concerns and manufacturers of the products used in every-day cooking to delve into the matter more deeply, micro-baking under the watchful eye of the camera is significant because it sets an advanced standard for research

Although Americans have won a reputation for being lovers of good food, progress in the science of cooking has been slow It may not seem so with the millions of dollars that have been spent on the scientific studies of various food products in the laboratories since the discovery of vitamins, or with the electrical gadgets and modern devices that facilitate the preparation of meals, or with the new methods of processing foods to preserve their vitamin and mineral content Yet, in spite of these innova-

Four cakes baked with same amount of ingredients. Cake at right was made with a shortening that coated each air cell evenly



All pictures courtesy Swift and Company

Cake (above) made with normal batter. Tough cake with large holes and tunnels (top right) lacked shortening. Made with too much sugar (lower right), cake was too weak to support self

• LOOKING AHEAD •

Photomicroscopy applied to many other phases of food study New knowledge of reactions formerly used empirically Techniques evolved for employing photography in research aimed at improving accepted but still inefficient processes

tions, our knowledge of the culinary art has been derived not so much through scientific fact as from the experience passed on from one generation to the next.

Some improvements in the baked goods on the market have taken place within the last ten years, due to the constant efforts of the baking industry, notwithstanding sugar shortages and other war-time handicaps These advances, however, have been brought about, for the most part, through the efforts of one baker attempting to match another in putting out a superior product

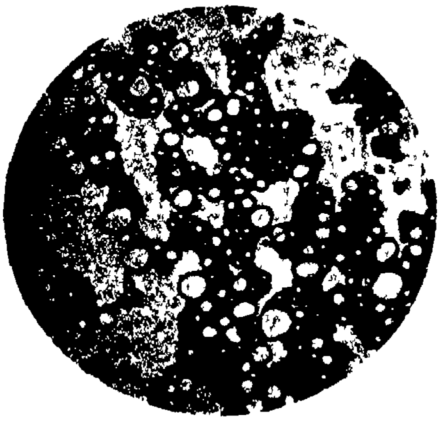
With micro-baking and its attendant movie film, these improvements will be extended still further, and guesswork that has gone into baking will, if the hopes of scientists are fully realized, be largely eliminated. Bakers will gain an understanding of the difficulties they encounter every day And consumers will look forward to receiving increased dollar value, while each piece of baked goods will be uniformly as near perfect as any other Improvements of the various ingredients utilized will also work as a means toward product control

PRODUCTION BROUGHT PROBLEMS — Producing a full-color motion picture whose basic purpose was to reveal with microscopic detail the inside story of the baking of a cake presented problems of no mean proportions. First, in order to photograph the inside structure of a cake, it was necessary to use a batter that was sufficiently thin to transmit light readily After considerable experimentation, a batter was formulated which formed a layer on the "pan" no thicker than a sheet of ordinary tissue paper The baking "pan" also presented considerable difficulty A piece of glass, not quite as thick as regular window glass, was finally selected Another serious headache was the oven It had to develop enough heat to bake the batter, and yet be small enough to fit on the stage of the 250-power microscope A thin piece of insulating material, through whose length a hole was drilled, was found to serve the purpose A length of resistance wire placed in hole served as a heating element. The entire oven when complete was no more than a half inch in height.

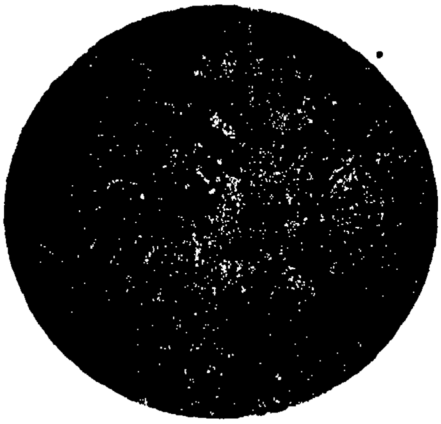
In order to expose the color film properly, a light of very high intensity was required This was supplied by a powerful carbon arc lamp Then the motion picture camera was attached to the microscope to record the reactions during the baking In all, it was a year before all the difficulties involved in such a set up were ironed out

As the experiment progressed, new problems were met It was difficult to identify the ingredients in the cake To overcome this, the shortening was colored red with an oil-soluble dye which would not affect the color of the water component Flour was dyed purple by adding a small amount of iodine It was unnecessary to color the sugar and baking powder as these ingredients quickly dissolved into the liquid When their solution was complete they were no longer distinguishable through the microscope

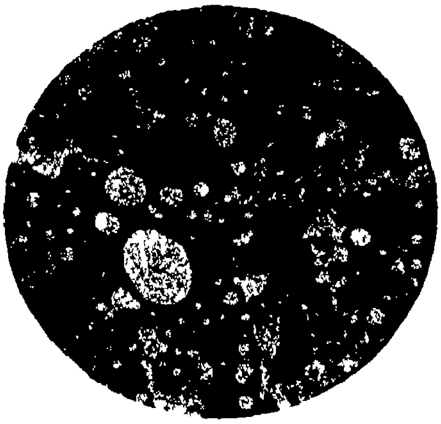
PARTICLES MOVE — As the baking on the little glass slide of the oven commenced, each little particle, each air cell, each unit of flour, each shortening pool —everything that was visible through the microscope—began to move There was an increased rush



Normal batter under microscope



Lack of fat—too few air cells



Too much sugar—framework weak

of activity as the heat inside the cake increased Air bubbles collided, and some broke open as the baking progressed

One of the important factors brought out through the microscopic study was that the air cells were found only in the shortening, and in no other portion of the batter It was further revealed that the gas which was given off by the baking powder was not visible through the microscope It was apparently dissolved by the water of the batter and then discharged into the air cells which had been creamed into the batter with the shortening These cells puffed up like tiny balloons during the baking

When the baking was almost finished, every tiny particle was rushing around violently but, as the cake began to set, the movement subsided While the particles were in motion, each one appeared to follow an upward sweep, just as air tends to rise from a hot radiator across the ceiling of a room As the cake assumed a rigid structure, hundreds of air cells within the batter began to explode This took place when the movement of the various particles ceased, and was what formed the texture of the cake

An interesting method was employed in testing the cake to tell when it was done Here the housewives' favorite "broom-straw" test naturally could not be applied The cake-baking scientists were aware that each grain of wheat-flour starch appears to be marked by a cross if it is observed under polarized light So they reasoned that by watching the cake under polarized light they could tell exactly when it was done, for at this point the cross marking the wheat starch would disappear completely

At the final stage of the cake baking, wholly unexpected color effects could be observed, as though a motion picture producer of the microscopic world had arranged a grand finale When polarized light was brought into the experiment, sugar crystals took on all the shades of the rainbow As they rotated in the light, they sparkled as brilliantly as diamonds

BAKERS GAIN INSIGHT — Through micro-baking the baking industry has gained an insight into its science that was not possible before the film was produced Bakers have learned that little things make a big difference in striving for better products As an example, they have learned that only slight differences in the shortening will make a big difference in the quality, volume, and texture of the cake when it is done The volume of the finished product is dependent on the ability of the shortening to take up air If too little fat is used the air cells are unevenly dispersed throughout the batter

In the second place, the film has taught bakers a considerable amount about formula balance They have found out why a tough cake has large holes and tunnels running through it, and why a tender cake falls in the oven—not, as many suppose, because the oven door was slammed, when too much sugar is used, the air cells move faster than they should, weakening the framework of the cake Micro-baking has also revealed what determines good flour, and why some cakes are heavy

WHY CAKE WAS CHOSEN — In carrying on the the original experiments and photographing the results through a microscope, a cake was chosen as the subject of the investigation because in the baking of cakes a greater chemical reaction occurs than in other types of food Technicians have, however, already commenced studies of bread dough, and it is expected that more of these will be made, as well as examinations of the ingredients of pies and cookies

In addition to aiding the commercial baker, micro-baking will prove an asset to those who take pride in baking in their own kitchens, for with superior grades of flour, sugar, shortening, and other materials, superior cakes and pies of their own making will grace their tables

Unfortunately, the equipment necessary for carrying on research in micro-baking is expensive While it is expected that larger bakeries will shortly acquire their own photomicrographic equipment, it is likely to be some time before the majority will be able to do so and gain first hand knowledge on the subject

So, while progress along this line may be slow, the first steps have been taken, a sound groundwork laid, standards and operating procedures established Baked products will be better for the knowledge already gained, and steady improvements will be noted as further investigations are pressed forward

With what has been accomplished through cinema photomicroscopy in the field of baking as an incentive, other branches of foods preparation, handling, and production can be expected to adopt techniques comparable to micro-baking to yield uniformly better tasting, more nutritious foods of all types.

SCIENTIFIC AMERICAN'S Industrial Digest

MOCK-UPS OF BUILDINGS

Aid Laymen in Visualizing Projected Construction

"SEEING is believing," and modern architects and contractors are now making this adage serve their clients by the use of what are known in the industry as "mock-ups"—full scale models of sections or features of the planned building

In its work on the $6,000,000 Harvey S Firestone Memorial Library, now under construction at Princeton University, the Turner Construction Company built several mock-ups at the suggestion and under the supervision of the architects, Robert B O'Connor and Walter H Kilham, Jr The success of these models in interpreting construction features to the laymen who are concerned with the building proved that one mock-up is worth many words and blue prints

Basic areas in the planning of the Firestone Library, which will be the largest open stack library ever built, are the 18 by 24 foot bays, adaptable to stack, study, or seminar use In order to determine the most satisfactory ceiling height, lighting arrangement, and equipment, the construction company under the direction of the architects, built four model bays in the Princeton riding hall Ceilings of two of the bays were attached to pulley arrangements so that the effect of various heights might be tried out

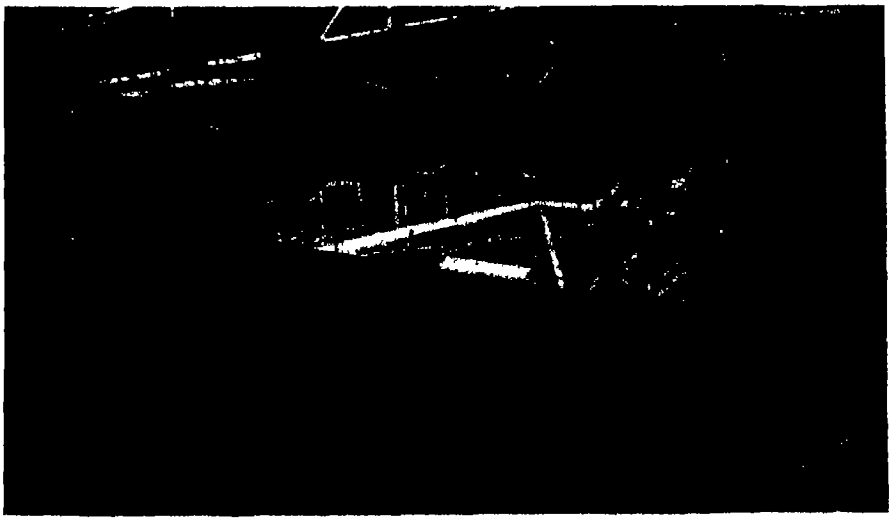
Incandescent lighting was installed in one bay and fluorescent in another Members of the University's Cooperative Committee on Library Building Plans tested the two systems and a decision was reached on the basis of their recommendations

The library is to contain more than 650 individual study cubicles or carrels for student use Five such carrels were installed in the mock-ups and various types of lighting were demonstrated in actual use Other equipment such as book stacks were also tried out in the full size model bays

Working models not only succeeded in making architectural plans three dimensional and easily understood by the laymen directly concerned with planning and use of the library, but resulted in general agreement between professionals and laymen on details of construction In deciding, for instance, on the height of the ceiling, lay consultants agreed on a height of eight feet four inches which closely paralleled the recommendations of technical experts

The mock-up principle was also applied to the exterior of the Princeton library building Several patterns of stone work were under consideration for the outside walls of the building It is difficult to look at samples of rock and visualize their appearance in a wall, so the Turner Construction Company built three wall sections about six feet high, side by side, and of different types It was then possible to compare the styles of masonry and type of materials and reach a satisfactory decision

"Mock-ups are proving to be of great value on large scale production projects," say officials of the Turner Construction Company "The small additional cost is easily offset by preventing a client's possible dissatisfaction resulting from the difficulty of visualizing, from blue prints and descriptions, the installations as they will actually appear"



Movable ceilings in two right hand models permit testing various ceiling-heights

IMPROVED CATALYSTS

Developed By Electro-Magnetic Process

THE CHEMICAL industries spend fantastic sums in making, replacing, and improving catalysts which make possible the economical manufacture of gasoline, fertilizers, plastics, drugs, and many other products A new magnetic technique for designing still more efficient catalysts promises wide-spread savings in time and money

Developed at Northwestern University, the new process has already yielded better catalysts for several applications, and it is possible that it will divulge at least a partial answer to the old problem of "how does a catalyst work" This same technique is also being applied to the study of high polymers, such as plastics and rubber, and to cellulose It enables chemists to tell to what extent certain groups of molecules are arranged in an orderly fashion

In using the magentic technique, a sample of the catalyst to be tested is chilled in liquid nitrogen and then suspended by a thin quartz fiber between the poles of a powerful electro-magnet Under the influence of the magnet, the catalyst turns slightly Changing the angle at which the catalyst is suspended, the chemist performs the experiment several times, each time observing the amount of twist due to magnetic attraction.—*H C E J*

JET THRUST AUGMENTED

By Burning Fuel in Engine's Exhaust Stream

INSTALLED downstream from the turbine of a conventional jet engine, a device called an "after burner" can add more than one third to the power plant's normal propulsive thrust, giving added power for take-off, during combat conditions, and on all occasions where extra speed are required This is accomplished by spraying fuel into the tail-pipe where its combustion adds mass and velocity to the gases of the jet stream.

This after burner, developed by the Ryan Aeronautical Company, is in effect a ram-jet engine attached to a turbo-jet The after burner application is simpler than the ram-jet, however, because the inlet velocities, pressures, and temperatures are higher Since the ram-jet depends solely on its speed to compress the air rushing in its nose, it has to be launched by rockets to attain the initial 500 mile-an-hour speed required for it to operate effectively But with the after burner, the speed of the air stream in the tail-pipe is well above that needed to make the ram-jet operate, so that the use of the basic ram-jet configuration as a thrust-augmentation device is logical and easily accomplished

Fuel consumption of the after burner at low speeds is high compared to the jet engine, but at very high speeds it is more economical of fuel than the turbo-jet.

One of the unique advantages of the use of an after burner with a turbo-jet engine is the fact that this method of augmenting thrust does not affect the operation of the turbo-jet by imposing additional stresses upon it Since turbo-jet power plants are operating near the critical stress limits of the turbine components, the after burner is an especially desirable method for increasing thrust This is not the case with water injection and most other methods which are employed to attain thrust augmentation

With gasoline used as a fuel in an internal combustion engine, a fuel-air-mixture ratio of 1 to 16 is necessary to obtain complete combustion of the oxygen in the air which is sucked into the cylinders. In contrast, the turbo-jet engine operates at a fuel-air ratio of 1 to 50, and as a consequence there is a great deal of unburned oxygen in the jet stream. The quantity of this unburned oxygen, then, is the limiting factor in the amount of thrust augmentation which it is possible to attain.

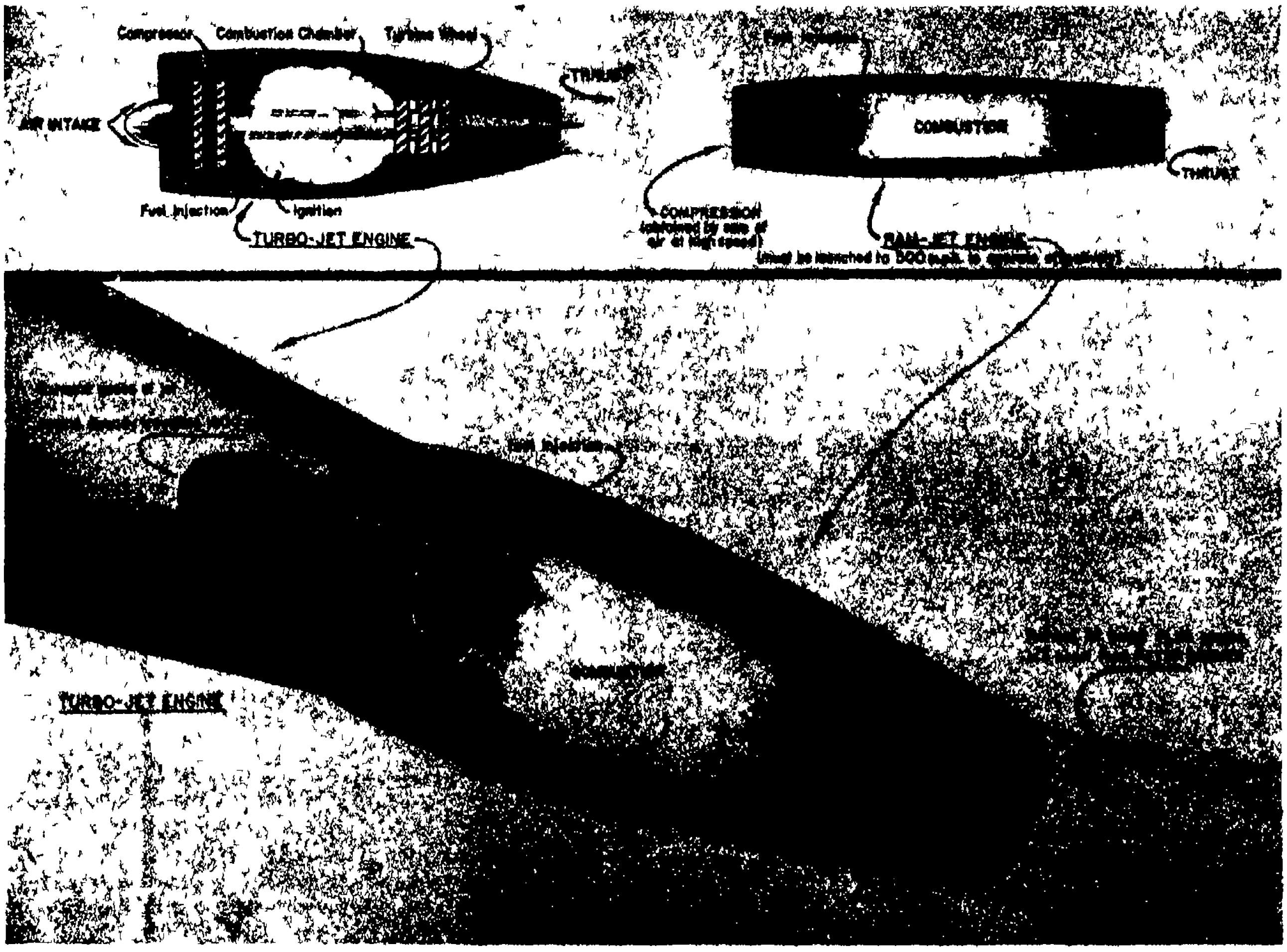
Unlike the turbo-jet, which is limited by the stresses imposed in the rotating turbine blades and temperature considerations, the after burner is a completely static mechanism and can be cooled below critical temperatures

Essentially, the use of the after burner permits raising the fuel-air ratio of the combustible mixture to the limit of the chemistry of combustion, whereas the turbo-jet alone is limited by the physical requirements of the turbine blading

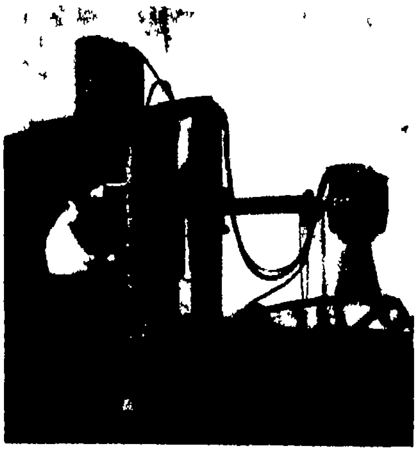
RAILROAD X-RAY

Checks Metal in Cars, Locomotives, Rails, for Internal Flaws

EMBODYING the most modern techniques for examining steel, aluminum, brass, and other metals used



Turbo-jet and ram-jet (above) are combined (below) for increased thrust



250,000-volt mobile X-ray unit checks a side frame for a freight car truck

in rails, locomotives, cars, and other equipment, a new X-ray laboratory assures increased safety of railroad operation. Thus technical progress in the field of radiographic testing of metals for internal flaws has been utilized by the Pennsylvania Railroad.

In the X-ray plant just opened, as an addition to the Pennsylvania Railroad Test Department, photographs are taken through metals to provide assurance against such internal defects as concealed cracks, imperfectly welded joints, cavities due to shrinkage of metal during cooling, and the like.

To use this new technique, a 250,000-volt mobile X-ray machine is mounted on automobile wheels so that it may be used either in the specially constructed laboratory building, or, when some very large object such as a locomotive boiler is to be examined, in the adjacent construction and repair shops. It can examine the internal structure of metals as much as three inches thick.

The laboratory building, equipped with 18-inch concrete walls to permit the use of X-ray equipment as powerful as 2,000,000 volts, includes a dark room for immediate development of X-ray photographs and equipment for projecting them for close examination by engineers skilled in detecting the slightest flaw depicted by the photographs.

MICROWAVE SPEED METER

Finds Vehicles' Speed by Measuring Shift of Wavelength

A speed meter, having numerous applications in traffic engineering studies, operates on the principle that a radio wave reflected from a moving target will shift its wavelength in proportion to the speed of movement of the target. Microwave energy is radiated from the antenna unit, a portion of the energy striking the surface of the vehicle and being reflected back to the unit. The direct and the reflected signals are received and mixed, and the output signal contains the difference of frequency, which is in direct proportion to the vehicle speed in miles per hour. This speed is read on the linear scale of the meter, calibrated in miles per hour.

The speed range of this instrument, developed by the Automatic Signal Division of Eastern Industries, Inc., is 0 to 100 miles per hour, accuracy being within 2 miles per hour throughout the range. A spring-wound graphic recorder furnishes a record of the speed of the moving vehicle.—*K.H.*

HOSES HANDLE MATERIALS

And May Replace Conveyor Belts in Many Uses

During the pre-war years, materials handling systems were hampered by the fact that metal pipes were comparatively rigid, rubber hoses were destroyed by oils or solvents, flexible metal hoses were limited in their wall strengths.

Synthetic rubbers with new and war tested fabrics and other wall strengthening materials have greatly increased the abilities of rubber hoses to meet those problems. Among the results are more uses of liquids as carriers so materials can be pumped through hoses, and more use of pneumatic carrier systems having readily positionable intake nozzles and outlets.

The changes which are being made in the handling of normally dusty and otherwise difficult materials point to the elimination of the conveyor belt and the adoption of the hose. But this does not mean any changes in the houses selling the devices. The same companies make both.—*E.L.C.*

HEAT-TUBE MATERIAL

Of Aluminum Alloys Resists Action of Corrosion

Aluminum and many of its alloys have several chemical characteristics that fit them for use in condenser and heat-exchanger tubes. A new alloy combination, Alclad 3S, which is resistant to localized attack, is now being successfully used for such purposes.

The new material, developed by the Aluminum Company of America, has a central core of 3S aluminum, with a coating of another aluminum alloy, 72S, on one or both sides of the 3S core, the coated surface being intimately and integrally bonded to the core over its entire surface. The coating is anodic to the core, so that if an area of Alclad 3S sheet is exposed to corrosive water that starts a pit in the sheet surface, once the pit has penetrated the coating, it will not extend deeper into the core, but will broaden out along and parallel to the surface.

Over 250,000 Alclad 3S teakettles have been made and only five of these were reported as perforating over a four-year period. American Airlines found that fuel tanks made of Alclad 3S were still in good condition after 15,000 flying hours.

The cost of the Alclad 3S tubing per linear foot is about the same as that of seamless steel for tubes of smaller diameters, but is slightly higher for larger or heavier tubes. Aluminum alloy tubes have been used successfully in contact with cast iron or steel tube sheets, headers, or shells.—*F.P.P.*

CONVERTED PORTABLE WELDER

Uses Special Air Clamping Stationary Fixture

The flexibility with which resistance welding equipment can be adapted to specialized assembly problems in mass production is illustrated by a simple welding "machine" for assembling "universal" automotive radiator petcock wrenches. The machine was made up by converting standard portable spot-welding gun equipment to a stationary butt welding "machine" by use

Welds 150 wrenches per hour

of a special air clamping stationary fixture With this, a production of 150 completed double-end petcock wrenches per hour was obtained

The wrench consists of two U-shaped mild steel stampings of different sizes, welded one to each end of a bent steel rod Simple air-clamping dies hold the shank of the wrench The two jaws are dropped over specially formed electrodes of two standard hydraulic push guns mounted in place The guns move the petcock wrench jaws up to the shank under welding pressure to form the series butt weld

Clamping pressure is applied by means of an air cylinder controlled by an air valve mounted on the cylinder support where it is convenient to the operator Balance of the equipment consists of standard 50 kilo-volt amperes portable gun welding transformer, a standard air-hydraulic booster to apply welding pressure, and a simple weld timer, mounted on a nearby wall to control the welding cycle Electrodes, dies, cables, and transformers are all water-cooled

The arrangement, devised by the Progressive Welder Company, lends itself to maximum operator-comfort with high productivity, an operator standing or being seated (it's just as easy either way) in front of each of the two guns The operator at the right loads the wrench shank and one jaw, and works the air-clamp control The operator at the left loads the other wrench jaw, initiates the welding cycle by pressing the palm switch, and unloads the completed wrench

"COLDEST COLD" BATH

Employed in Research on Super-Cooled Metals

Production of the coldest cold ever attained—less than one degree above absolute zero or about 458 degrees below zero on the ordinary Fahrenheit thermometer—will enable scientists to uncover new facts about the behavior of super-cooled metals and to find ways to make use of such frigid temperatures Extremely low temperatures cause certain metals to behave in a strange manner, says Dr Aaron Wexler, who is conducting these experiments at the Research Laboratories of Westinghouse Electric Corporation

"If an electric current is set up in a ring of a certain type metal while it is immersed in a super-cooled liquid," says Dr Wexler, "the current will continue to flow without loss even after the source of current is removed This is because such a super-cooled ring will offer no resistance to the flow of current The same ring at room temperature will resist the electrical flow and cause losses in the form of heat"

It would be theoretically possible to super-cool an electric transmission line so that there would be no loss of power from generator to user, Dr Wexler says, but the cost of providing a constant source of refrigeration for the power lines makes this impractical

Dr Wexler produces his super-cold temperatures by changing gaseous helium to the liquid form, causing a drop of some 520 degrees, Fahrenheit The helium gas, in ultra-pure form, is raised to a high pressure by passing it through a four-stage compressor system This gas under high pressure then is put to work driving two piston engines, and in so doing gives up a large amount of its energy in the form of heat—thus cooling the gas

The cold expanded gas is used to cool incoming high-pressure gas in a continuous process Finally, a point is reached where the cold being produced inside the apparatus just balances the heat leaking into the system

To get to the temperature of liquid helium—four degrees above absolute zero—a small portion of the high pressure gas, pre-cooled by gas from the engines, is expanded through a tiny opening Temperatures a fraction above absolute zero can be obtained by pumping a vacuum above this liquid helium

Dr. Aaron Wexler—super-cold specialist

The liquid "cold" is bottled up in a five foot deep cylinder in the center of the apparatus Metals to be studied can be lowered into the cylinder, which is carefully insulated to prevent heat from leaking in

Liquid helium temperatures are too low to be measured by the ordinary thermometer To find out how cold it is in the helium "bath," the Westinghouse scientist measures the pressure of the vapor above the helium From this pressure reading the temperature can be calculated

WHEAT-MOVING HOSE

Of Rubber, Last Longer Stays Cooler Than Metal Tube

Rubber has long been known as a transportation medium in divergent fields one of the newest of which is a rubber hose used to unload wheat by suction The hose, made by The B F Goodrich Company, replaces a flexible metal tubing which broke frequently due to failure caused by the friction of the wheat The metal tube was too hot to touch when the system was in operation, and was heavy and cumbersome

Unloading wheat through rubber hose

A 35-foot length of six-inch diameter hose permits the grain to be transported at high velocity, the smooth lining producing less friction than the metal.

DRYING LUMBER

Accomplished by Extracting Moisture With Solvent

Recently developed, a process for drying lumber saves time and gives a product which is lighter in color, less prone to warping, and, in the case of knotty wood, is easier to paint because the pitch is removed Reported to be four times as fast as ordinary kiln-drying, the new method is based on the ability of a water-miscible solvent, such as acetone, to extract water from wood.

The lumber is stacked and bound in packages which are stood endwise in an extracting tank There it is sprayed with solvent at the rate of 100 gallons per minute. The spent solvent, together with water and organic extractives, goes to a reboiler, which sends part of the solvent back to the extractor and part to a still. In the still, the solvent is separated from the water and pitch, which are recovered as a partial emulsion. The organic materials, predominantly fatty acids (from sapwood) and resins (from heart wood) rise to the top and are decanted. Other by-products are turpentine and neutral fats.

Finally, the lumber is treated with superheated steam, bringing the acetone content down to about 0.2 percent of the weight of the wood. Drying to 3 percent water is possible but, commercially, 8 to 13 percent is practical.

Now in the pilot-plant stage at the Shevelin-Hixon Company mill, the new procedure was developed by Albert Hermann and A. B. Anderson of the Western Pine Association Laboratories.—*H. C. E. J.*

MOTORIZED HOISTS

Made Easier to Manage, Save Time, Promote Safety

Familiar to the incidental handling of materials, positioning of heavy chucks, and moving of machines is the task of moving and mounting hoists. It usually takes two men and a block and falls to position a one-ton capacity motorized hoist for operation.

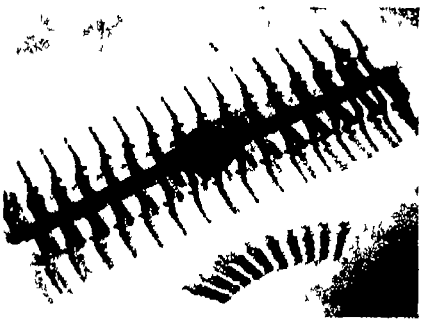
Following the modern trend toward lighter weight for the same strength, new motorized hoists are so light that one man can handle them. Saving of man-power hours and adding to the safety of handling the hoists are among the gains. But the principal gain reported by the users is that of encouraging the men to use hoists where they formerly used slower and more dangerous equipment.—*E. L. C.*

NYLON KNEE

For Phonograph Needle Is Said to Have Less Scratch, Longer Life

An interesting new use for nylon is in the "knee" of a phonograph needle put on the market by Webster-Chicago Corporation and Decca Records, Inc.

A number of nylon's outstanding characteristics are put to good account in this application. For example, the needle takes advantage of the pronounced internal resistance or self-damping characteristic of nylon to minimize mechanical resonance distortion such as needle scratch and surface noises, and to obtain improved tracking at high and low frequencies at reduced needle pressure. The nylon knee, molded by National Organ Supply Company, does this by absorbing vertical shocks caused by the pinch effect of record grooves and also levels out horizontal shocks of needle bounce.


Groups of 32 knees are injection molded

The net result is improved reproduction quality, prolonged record life, and extended useful function of the hand-polished sapphire jewel tip, which is said to be good for as many as 15,000 playings.

The properties sought in the knee for this needle are listed below, all of which were met by nylon:

1. Very light weight, minimizing inertia of moving parts.
2. Resistance to fatigue and crystallization under service conditions.
3. Good mechanical strength and toughness.
4. Excellent elastic memory and recovery.
5. Good negative cold-flow characteristics.
6. Ability to be injection molded in the interest of high production, as well as uniformity and stability.
7. Very high melting temperature.
8. Chemical stability and resistance to moisture.
9. Non-magnetic and non-electrostatic properties.

RADAR LIGHTHOUSE

Appears as Bright Point on Ship's Radar Screen

Emitting signals which can be detected by radar-equipped ships, a small radar beacon for lighthouses has been built by the General Electric Company for the United States Coast Guard. The unit should prove useful during periods of fog, rain, snow, and sleet, when normal sight and sound warnings are limited.

The signal from the electronic beacon appears as a bright spot on the radar's cathode-ray tube, showing the exact direction of the beacon, in much the same way as the conventional lighthouse is located optically by the beam of light it emits.—*K. H.*

WELDING BOOTHS

With Individual Exhaust Outlets, High-Intensity Lighting

Considered to be one of the most modern welding-booth systems in the country is the one at Erie Meter Systems, Inc. Each booth has an individual exhaust outlet, arranged for each operator, which is so regulated that it may be turned off as desired, and there is a large light in each booth, strong enough to permit the operator to see the outlines of the piece on which he is working even though his shield is down.

Each booth has an individually controlled exhaust system and a high-intensity lamp

New Products

HOT AIR GENERATOR

Speeds Many Industrial Heating And Drying Operations

Producing homogeneous hot air of controllable velocity, temperature, quantity, and pressure, a heated air generator found its first application in speeding the common shipyard operation of drying ship's motors and engine-room machinery which has either been flooded or covered with moisture through condensation

However, additional applications for the new generator will be found wherever the problem of cleaning and drying machinery exists—on ships, in aircraft maintenance shops, in hotels, large buildings, laundries, and so on Other uses for the hot air generator, developed by Todd Shipyards Corporation, will include various manufacturing processes such as pre-heating, melting, annealing, dehydrating, aerating, sterilizing, hardening, enameling, cooling (by shutting off the heat and using it as a blower), tempering, curing, refining, and plating

A further use around motors of the device, called THAG (Todd Heated Air Generator), is in connection with cleaning and painting Through usage, main propulsion machinery and auxiliary motors acquire a coating of grease mixed with carbon dust After a time this coating becomes quite thick and is difficult to remove By applying hot air at about 200 degrees, Fahrenheit, to the part, the grease melts readily and the area can be rapidly washed with carbon tetrachloride which evaporates quickly After a cleaning it is customary to paint the exteriors of electrical equipment with a special varnish which must be baked to give it a hard and longer-lasting protective finish This operation, formerly done with infra-red lamps, is now accomplished much faster and cheaper with the controlled hot air generator

Hot air generator on freighter's deck drives moisture from the engine room

SPRAYED HARD-FACING

Is Smooth, Thin, Uniform Coat Inexpensively Applied

A new method for hard-facing by using a metallizing gun and a "wire" composed of a powdered hard-facing alloy extruded with a plastic binder, attains the previously difficult objective of applying smooth, uniform, relatively thin hard coatings in a highly practical and inexpensive manner

During the Sprayweld operation, the plastic binder is completely volatilized, and the deposit consists entirely of the metallic constituent. Subsequent fusing, with any fusing torch or with an attachment on a metallizing gun results in a coating alloyed to the base which is, according to the Metallizing Engineering Company, the developer, physically and chemically identical to hard-facings of the same alloy applied by other methods

The alloy used in the "wire," which is called Metco-Weld H, is unusual in many respects It possesses excellent resistance to abrasion—will outwear hardened steel 3 to 10 times for this type of service—and it resists corrosion better than stainless steel under most of the conditions for which stainless is generally used. It combines a low melting point with a long range of plasticity (1850 degrees to 2050 degrees, Fahrenheit) It is reported to have high strength at red heat and exceptional resistance to oxidation

SHEET FEED TABLE

Elevates Hydraulically, Will Support 10,000 Pounds

For handling and feeding to presses and shears loads of sheet steel up to 10,000 pounds, a new hydraulic toggle-lever-type table is portable for transporting loads. The hydraulic elevation allows leveling of load with press bed for efficient horizontal feeding. Stock may be loaded on the table by fork truck or by overhead means, either in the stock room or at the press. The advantage of the toggle-lever design is the full support given to the entire length of the table top—particularly desirable in the case of long, heavy loads Lifting action is obtained by a hydraulic pump through hydraulic cylinders which operate laterally against the toggle-lever mechanism. The table guides are inverted so that no uprights extend above table top

The table top is 30 inches wide by 96 inches long The lowered height is 22 inches, elevated height 34 inches, giving a total lift of 12 inches The table, manufactured by the Lyon-Raymond Corporation, is equipped with one set of 12 inch diameter wheels, one set of eight inch diameter swivel casters, a floor lock, and a two-speed hydraulic foot pump The pump may be mounted on the unit or furnished with a flexible hose attachment for placing wherever it is most convenient for the operator A motor-driven pump with push button controls is an optional feature

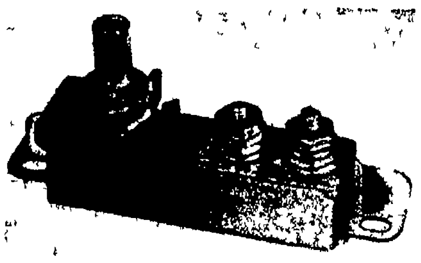
Elevates to maximum height of 34 inches

Extensions for the table top may be furnished for the support of loads wider than 30 inches and longer than 96 inches. Also available are superstructures of any thickness to increase height of table top, retaining the 12 inch lift These features insure the adaptation of the table to different press heights and material sizes

HEAT REGULATOR

For Flat-Surface Appliances Is Accurate Despite Shock

Designed for electrical appliances, a new type of thermostat provides safe, constant, accurate, fast-acting heat control under the most severe operating conditions. The thermostat, called the Fenwal Appliance Thermoswitch Control, is said to maintain its efficiency even though the appliance in which it is installed may be continuously exposed to shock, vibration, tampering, and other outside influences The control, manufactured by Fenwal Incorporated, is available in two models the high temperature model which provides control over the wide range of 175 degrees, Fahrenheit, to 600 degrees, Fahrenheit, and the low temperature model providing critical control throughout its range of 50 degrees,



High- or low-heat models available

Fahrenheit, to 250 degrees, Fahrenheit.

The welded, one-piece case and cover assures a rugged, tamper-proof unit and stable temperature settings. Torque applied to the terminal binding posts, it is claimed, will not shift contact support members, and the temperature adjusting screw will not drift under normal vibration. The mounting bracket provides for side or bottom mounting, or a cross-mounting bracket is available for special applications.

The control is designed to operate at 110 volt A.C., 60 cycles, and to control temperatures in flat-surface applications, including flat irons, automatic ironers, waffle irons, sterilizers, pasteurizers, dairy water heaters, hot plates, and so on.

RESPIRATOR FILTER

Of Chemically Treated Felt Is Small with High Efficiency

PROTECTING industrial workers exposed to poisonous and disease-producing dusts smaller in diameter than 24 millionths of an inch, a new dust filter, first of its kind, consists of a felt which has been chemically treated so that its ability to prevent the passage of dust is 40 times greater than untreated filters. In addition, a new respirator has been designed to utilize the high efficiency of the new filter which is so versatile it can protect the respiratory system against a combination of all types of contaminating dusts in air.

The filter protects workers against poisonous arsenic, lead, cadmium, and chromium dusts, silica dust responsible for silicosis, a frequently fatal lung disease, and nuisance dusts produced by coal, limestone, iron ore, and aluminum operations.

Filter (in man's hand) is black with the dust that would have been inhaled

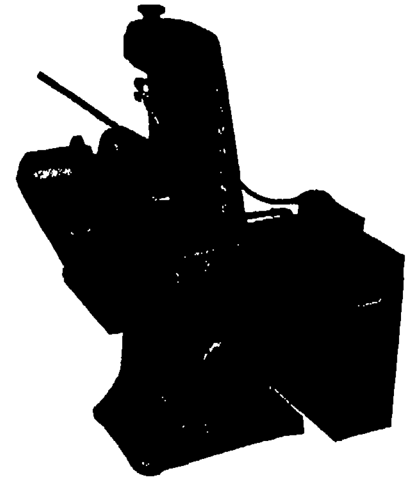
The chemically treated filter, one eighth inch thick and slightly over five square inches in area, is the equivalent in dust filtering efficiency of previous untreated filters of the same thickness and 42 square inches or more in area. This increased efficiency is reported to make it possible to produce a respirator filter of the smallest area so far developed without making it more difficult for the wearer to breathe through it, thus increasing his field of vision and reducing the respirator's weight.

Filtering action of previous respirator filters was primarily dependent on the smallness of the openings in the filter's interior fiber structure through which air passes. Functioning of the new filter is not contingent on the size of the openings but on a chemical treatment which radically changes the physical features of the fibers in such a way that dust filtering efficiency is greatly increased.

CENTERLESS GRINDER

Operates Wet or Dry, Takes Rods, Bars, or Tubes

USING coated abrasive belts for grinding and polishing rods, bars, or tubes from one-eighth to one and one-quarter inches in diameter, a new centerless grinder will remove up to 0.005 inch per pass on ferrous metals, and up to 0.10 inch on non-ferrous. Accuracy on production items is 0.001 inch, with closer limits on some work. The work supports will handle half-inch bars up to 18 inches in length, and one inch bars up to eight inches long.



Grinds to tolerance of 0.001 inch

This machine, made by Hammond Machinery Builders, Inc., uses an endless abrasive belt which is four inches wide and 60 inches long. It may be operated wet or dry, although for better finishes, higher production, and longer belt-life, wet operation is recommended.

Two methods of feeding are employed with the grinder, designated Model OD-1 through-feed and in-feed. The through-feed method is generally used, and is accomplished by swinging the regulating wheel on its horizontal axis from zero to 12 degrees. The rate of feed can be varied from zero to 18 feet per minute.

TEMPERATURE CONTROL

For Electric Furnace Regulates Current Flow Electronically

MAINTAINING the temperature of electrically heated ovens within less than 1/10 degree, Fahrenheit, at temperatures up to 1200 degrees, Fahrenheit, a proportioning electronic temperature controller adjusts the input power to the oven. The power flows continuously rather than in "on-off" cycles. Rapid achievement of temperature is accomplished because the instrument does not throttle power until the furnace reaches a point within 15 degrees, Fahrenheit, of the preset temperature. Quick and accurate selection of temperature is made by means of a vernier type dial. The controller, manufactured by W. S. Macdonald and Company, operates on 110 volts A.C., but can be used with furnaces requiring 110 volts or 220 volts A.C. The unit measures 19 inches wide by 10½ by 10½ inches, and can readily be adapted to particular installations.

Continuous control, not on-off cycles

DUAL-METAL WIRE

Electroplated, Then Drawn, Will Not Chip or Flake

CAPABLE of being bent, swaged, hammered, woven, or twisted without flaking, a new type of electroplated and drawn wire has a wide range of manufacturing applications in radio tubes, incandescent and fluorescent lamps, electrical devices and appliances, jewelry, and wire goods. "Fernicklon," trade name of this new product of the Kenmore Metals Corporation, is the result of an entirely new process. Metal rods of ¼ inch diameter are first electroplated continuously with high accuracy, then cold-drawn down to diameters as fine as 0.0038 inch. One inch of ¼ inch plated rod may produce as much as 100,000 feet of plated wire, permitting it to be ordered in continuous sections of almost any length.

Initial production includes steel wire

with nickel, copper wire with nickel or silver for radio tubes and lamps, tinsel wire, and many other wire products where finish and durability are required Die polish or satin finishes are available Because of its surface perfection and the absolute bond between its constituent metals, Fernicklon can be subjected to the severest climatic conditions when an anti-corrosive coating metal is used It can also be welded to form a product without destroying the coating at the point of the weld

GASKET CEMENT

Is Flexible, Resists Heat, Shock, and Vibration

Manufactured for automotive, airmotive, and wide industrial uses, a synthetic, flexible, deoxidized rubber cement, forms a permanent seal in pipe joints, gaskets, and places where flexibility is required to permit expansion and contraction of metals Since it is heat resisting, it makes an excellent head and exhaust gasket seal for regular automotive and airmotive repair, maintenance, and rebuilding applications It is claimed that it will not blow out under high pressure, and that its flexibility resists vibration and shock

Good adhesion as well as fast drying time are characteristics of this cement for sealing cork, rubber, fiber, paper and metal gaskets Industrial users have found the new material, called Gascacinch, to be satisfactory also as an industrial belt dressing

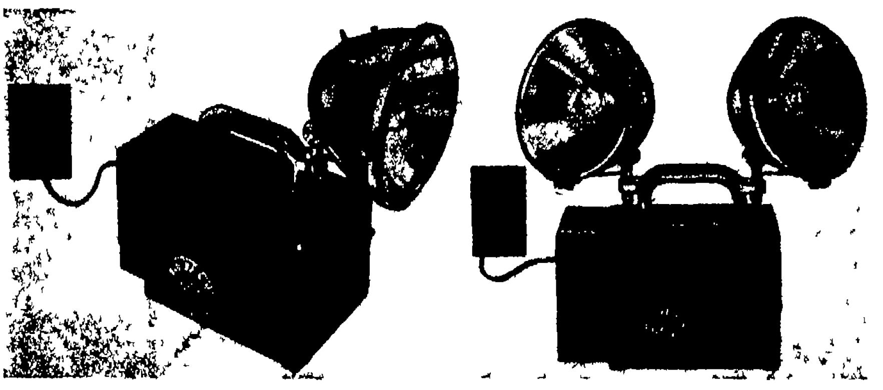
The cement, product of the Porter Manufacturing and Supply Company, holds gaskets in place tenaciously while assembling parts, and prevents troublesome sliding or slipping When set it is also resistant to aliphatic fuels and water

EMERGENCY FLOODLAMP

Switches on Automatically When Circuit Failure Occurs

For emergency use when a regular lighting circuit fails, a new battery-operated lamp answers the requirements of many communities whose local building laws demand emergency auxiliary lighting A switching relay in the lamp is connected to the regular lighting circuit through an extension cord When the circuit fails, the relay automatically turns on the powerful floodlamp The extension cord can be removed from the lighting circuit and placed in a space provided in the relay housing, thus transforming the unit into a portable hand lamp which can be switched on or off at will

Called the Big Beam Auxiliary Lamp, it is available in two models Model 801 with a single lamp head, and Model 802 with dual lamp heads The lamps, products of U-C Lite Manufacturing Company, are rustproof and weatherproof Lamp heads of both models can be turned a full 360 degrees in any direction, and both models are powered by four standard dry cells



Available with single or double lamp heads, the emergency units serve also as hand lamps

"SPONGE" RUBBER PAD

Has Nitrogen-Filled Cells Which "Give" but Will Not Flatten

Television tubes and other delicate equipment can now be protected against damage during shipment by spongelike cellular rubber pads

The pads, developed by United States Rubber Company, are readily fabricated from sheet material and will protect equipment weighing from five pounds to several hundred pounds They are said to be particularly useful for packing expensive television equipment and electronic devices

The rubber derives its cushioning ability from millions of microscopic cells filled with nitrogen The cells "give" slightly under pressure but do not flatten out as do the cells of regular sponge rubber

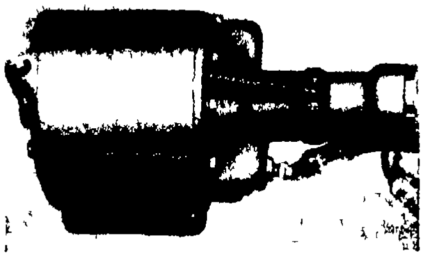
HYDRAULIC WELDING GUN

Assures Uniform Pressure, Reduces Flash, Pitting, and Burning

Using no springs, and insuring uniform point pressure regardless of the wear on the points, a new double-acting welding gun and booster is hydraulically operated Destructive burning and pitting at the weld are reduced to a minimum, and there is so little flash that operators using the gun are said to have discarded their heavy helmets during welding operations with no danger of eye injury Also, by the reduction of burning and of the sticking of points to metal, the service life of the points is considerably extended The minimum life of points used on automobile body production, operating at 3000 shots per hour, is reported to be 108,800 shots

The mechanical speed of the gun, made by Dalhart Engineering and Manufacturing Company, is limited only by the maximum speed at which the solenoid air valve can be operated Welding pressures may be varied by controlling air pressure on the booster inlet Thus a variety of metal thicknesses may be welded with a single gun Small cylinders and high pressures combine to make this light-weight, compact tool adapted to a wide variety of applications

Minimizes pitting, burning, and flash



Booster unit for welding gun

PAINT ADDITIVE

Aids Hardness, Color, and Water Resistance of Coatings

Important qualities in paint—wear and mar resistance, gloss and color retention, and quick-drying—are reported to be improved and another quality, better water and alkali resistance, added by a chemical which is incorporated with the other ingredients of paints, enamels, varnishes, and similar products at the time of manufacture

Chemically, this material, called Pentek, is a commercial version of pentaerythritol, an alcohol derived from formaldehyde When decreasing imports of tung oil resulted from the Sino-Japanese war, paint manufacturers were required to substitute domestic oils for the imported raw materials They found that in some ways the resulting finishes were not up to previous standards However, when Pentek was incorporated, surface coatings were produced which, according to the Heyden Chemical Corporation, who pioneered in the development of the chemical, exceeded many of these standards The water and alkali resistance factor, for instance, is reported to make Pentek paint superior for use on fences, shutters, window trim, and similar exterior woodwork and metal In the interior of a house, the increased mar resistance and high gloss of a Pentek varnish results in longer lasting, better looking floor finishes

The water resistance factor applies again in painting bathrooms and for doors and light-colored woodwork which may become finger-marked Dirt can be washed off repeatedly without injuring the finish or causing fading

The color retention imparted by the chemical is particularly valuable in kitchens where light or white paint tends to yellow and smudge because of smoke and fumes from the stove

Ingenious New
Technical Methods
To Help You
Simplify Production

New Automatic Device Provides Up-to-the-Minute Visual Record

The new CHART O MATIC provides an instant visual record of all production, shipments, purchases, absenteeism, etc Avoids inventory surpluses Guides purchasing department giving constant picture of all parts and supplies on hand Requisitions can be made direct from chart Information from all departments transmitted to operator by Telautograph permits instant recording on CHART-O MATIC Does away with big wall charts and card systems and tedious, time-consuming search for data that is often far from current With the CHART O-MATIC, the complete activities of the entire plant can be determined in an instant

The entire unit is easily portable and operates from 110 volts current Chart rotates in either direction by finger-tip control Speed may be governed by rheostat

New devices are proving their worth in saving time and reducing nervous tension on the job And modern plants throughout America are finding that chewing gum on the job helps relieve monotony and helps to keep workers alert That is why more plants every day are making Wrigley s Spearmint Gum available to their employees

Complete details may be obtained from Spiral Mfg Corporation, 3612 N Kilbourn Avenue Chicago 41, Illinois

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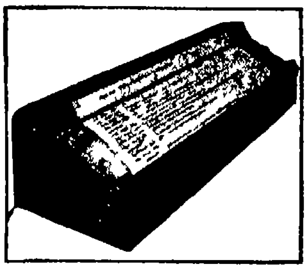


The New Chart-O-Matic

DUST COLLECTOR

Is Light, Portable, and Easily Cleaned

ESPECIALLY suited for laboratories where space is extremely limited and where quiet operation yet proportionately high dust storage is required, a new, low-cost, portable, bench-type dust collector is entirely self-contained and requires no installation other than simply placing it in position on the bench and plugging in to a regular power line outlet A ¼ horsepower, continuous duty motor turning at 1745 revolutions per minute and operating on 110 volt, single-phase power, drives a paddle-wheel fan which is capable of clearing chips and dust from grinding lint and strings from polishing and buffing, as well as sludge from pumice and other wet-finishing operations The hood which is fastened on this dust collector, designated Model 330 Dustkop by its manufacturer, Aget-Detroit Company, has a baffle, a light fixture for illumination of the work, and two removable trays for easy emptying of debris which drops from the work The two trays also eliminate mixing accumulated dusts from wet or dry work

Dust and dirt are removed by means of a drawer from the left side of the unit A hand crank on the side of the unit immediately above the dust drawer facilitates a quick and easy "shakedown" of the spun-glass filter material This spun-glass filter material is cheaply and easily renewed after repeated shakings

Gold and other precious metals can be reclaimed from the unit by removal of the dust from the collecting pan and also by melting it out of the spun-glass filter material

GERMICIDAL DEODORANT

Eliminates Strong Odors, Is Non-Poisonous

ACTUALLY destroying odors, instead of concealing or masking them, a new kind of deodorant was originally intended as an all-purpose bactericide Then the material was discovered to possess deodorizing properties which are now finding widespread use in eliminating odors at the source in large manufacturing plants and around garbage dumps and polluted streams Since the material eliminates the odor, its effect is longer-lasting than that of other deodorants

The material is a quaternary ammonium compound, and is known as Hyamine 1622 It can be used effectively against such odoriferous materials as garlic, onions, spoiled potatoes, or decayed fish Since it is used to kill germs and bacteria, it is effective in eliminating any kind of bacteria-induced putrefaction It is odorless, and at use-dilutions is harmless to humans and animals For surface odors, sponging or mopping with 0 1 to 0.5 percent solutions are recommended, and for space spraying 0 05 percent is satisfactory The material is available to manufacturers in commercial quantities either as the 25 percent aqueous solution or as finely powdered crystals

Commercial deodorizing has long depended upon materials which either cover obnoxious smells with pleasant ones, or deaden the sensitivity of the olfactory nerves In commercial tests in one pharmaceutical plant which manufactured a hormone during the war, the raw material used in this process developed an odor so powerful and persistent that it was impossible to conceal the smell for longer than a few days Yet with the development of Hyamine 1622, one scrubbing at a concentration of one part in a thousand eliminated the odor entirely and there has been no recurrence.

Manufacturers of disinfectants and other antiseptic preparations incorporate this deodorant, produced by the Rohm and Haas Company, in their consumer products These preparations include not only products for deodorizing, but also for sanitizing dishes and glassware in soda fountains, where it has proved 200 times more powerful against germs than carbolic acid Products containing Hyamine 1622 are used also in restaurants and bars, in disinfecting rinses for hopsital and veterinary service; and the sanitizing of dairy and food-processing equipment

FIRE EXTINGUISHER

Using Dry Chemical Is Simple to Operate, Easily Refilled

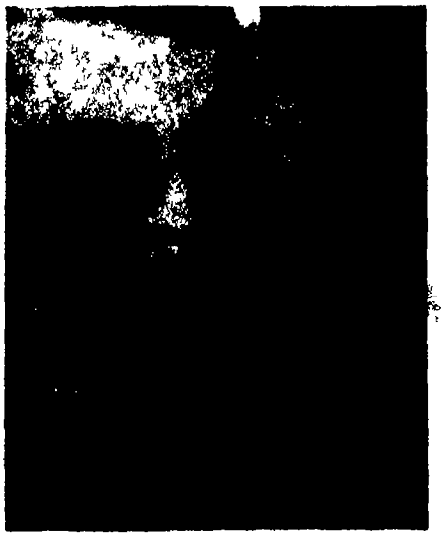
Designed for effective use by inexperienced operators, a new four pound dry chemical fire extinguisher is only 19⅛ inches long and three and one-half inches in diameter This extinguisher, product of the Ansul Chemical Company, is suitable for extinguishing fires in flammable liquids, gases, solids, and electrical equipment, and also for controlling fires in ordinary combustibles. The extinguishing agent used, Ansul Plus-Fifty Dry Chemical, is claimed to be non-toxic, non-corrosive, non-abrasive, and a non-conductor of electricity Maintenance is said to be greatly simplified and the extinguisher can be quickly recharged on the spot after use It is supplied with a quick-opening bracket for vertical or horizontal mounting in locations where space is limited

SAFETY GOGGLES

With Plastics Frames Are Sturdy, Light, and Easily Cleaned

Non-hazardous in the presence of fire and unaffected by oil and perspiration, cup-type safety goggles with Tenite frames have smooth surfaces which are easily cleaned, the safety-glass lenses can be removed for a thorough cleaning job inside and out

The extremely light weight of the Tennessee Eastman Corporation's Tenite is a considerable factor in making these Willson goggles comfortable to wear And this tough material withstands rough treatment without breakage It is pleasant to the skin in all temperatures Perforated metal pieces are inserted in the sides of the goggle frames for ventilation

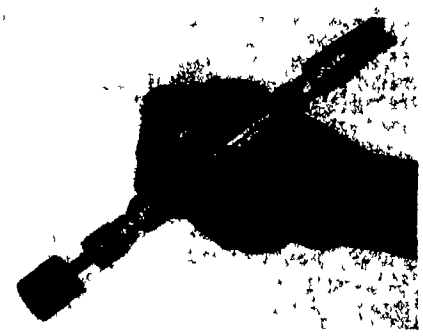


Goggles are light-weight, comfortable

HIGH-SPEED AIR DRILL

For Wood, Nonferrous Metals, Can Also Clean Dies, Molds

Especially designed for use on small drilling applications, a new high-speed air-drill has a speed of 26,000 revolutions per minute, and is equipped with a 0 to ¼ inch chuck and a lever throttle This new model is recommended for drilling wood and nonferrous metals such as brass, aluminum, and magnesium Also, it is well suited to cleaning stamping dies and molds Its high speed will clean, but is not powerful enough to remove metal, leaving die dimensions unaffected The tool, designated Model 7022, can be applied to the same type of work in glass and plastics molding plants The drill, produced by the Aro Equipment Corporation, is particularly adaptable for multiple mounting in jigs or fixtures where more than one hole must be drilled simultaneously Because of its small size, drills can be mounted close together

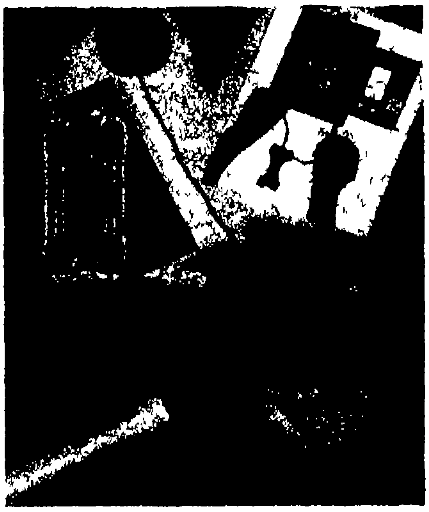


Air drill with cleaning attachment

HANDY NEON TESTER

Checks Continuity, Indicates Power Line Voltages

Consisting of an insulated sprocket around which is wound six feet of test wire with the test cord terminating at one end in a standard base plug, at the other end in two test prods, a new pocket continuity tester operates directly from any 110 volt base receptacle It is also adaptable to conventional line testing, indicating voltages from 75 to 600 volts The test lamp is located in one of the test prods, and is protected by a filtered circuit to eliminate all false indications caused by adjacent live wires, inductance, or body capacitance A high resistance is enclosed in the other test prod to avoid accidental grounds The filtered neon test circuit, by eliminating false glows, gives the equivalent test results of a large carbon lamp



Filtered tester gives no false glows

Inserting the attached plug into a base receptacle enables the user to check continuity with the test prods Bench testing of motor armatures, coils, fluorescent lamp units, radios, and other appliances is readily accomplished in this fashion The continuity testing features are adaptable to the quick checking of electrical circuits in automobiles and airplanes, and to tracing signal circuits such as in elevators

Power circuits of from 75 to 600 volts are tested by inserting a rubber plug into the self-contained socket on the frame of the device The test prods are then used in the conventional manner for location of blown fuses or detection of grounded appliances

Called the SureTest Universal Tester, it is a product of the Star Fuse Company, Inc, and weighs four ounces When not in use, the test prods are fastened to the frame around which the test wire is wound, and it can be carried conveniently in the vest pocket

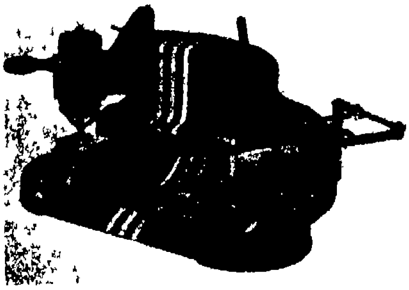
ENGRAVER-PROFILER

Has Pantograph For Precise Work By Untrained Hands

Featuring simple operation, a new profiling and engraving machine is equipped with a pantograph which permits accurate engraving in desired reductions even by inexperienced hands Operation requires only placing of lettering, templates, or drawings on one side of the machine and tracing with the arm of the pantograph which, while moving over the inscription, engraves the work-piece in full view of the operator The machine is driven by a universal electric motor, 110 volts, A C -D.C A standard ratio of three-to-one is achieved with the pantograph, but other ratios can be had on request

The operator can engrave his own templates in one-to-one ratio from drawings and thereafter reduce them for reproduction as required.

The adjustable vise of the unit will hold work up to five by eight inches and the machine will engrave areas up to four by four inches. The work table, with adjustable rulers and instantaneous cam-locks, permits the operator to assemble templates in a few seconds Copying of the text of the inscription and its distribution in symmetrical lines are absolutely accurate The vise is easily adjusted and can be locked in any position. It can also be quickly removed for substitution by a work table, or by a special fixture for mass-production engraving work Both the vise—with the work to be engraved—and the table with the assembled templates, are located in front of the operator so that he may observe the progress of work at all times A micrometer depth adjustment device allows engraving from hairline to deep cut. Convex or concave surfaces can be covered from a flat master, with uniform thickness of the engraved line



Engraves work up to four by four inches

The overall dimensions of this Automatic Engraving and Profiling Machine, as it is called by its manufacturer, Airdraulics, Inc, are 21 by 21 inches, overall height, 14 inches, and the total net weight, 42 pounds

SPOT WELDING TIMER

Set to Metal's Thickness, Assures Correct Welding Time

Eliminating guess-work and assuring uniform production in spot welding, an electronic welding timer gives precision control to the welding current flow Once set for a particular thickness of metal, timing becomes automatic throughout an entire production run

The Timatron Timer, as it is called, is designed to make installation simple and inexpensive on all types of spot-welding machines, and it can usually be installed in less than an hour The control has the capacity to time any machine up to 10 kilo-volt amperes, and is adjustable from .1 second to 5 seconds by a hand control covering any timing range which may be desired. The dial, which adjusts the timing period, is calibrated so that adjustment can be speedily made when switching from one thickness of metal to another.

The timer, produced by Ripley Company, Inc, makes it possible for a workman to produce a solid weld and eliminate defects common when the timing is left to the discretion of the operator, such as welds that will not hold due to short timing, or burning and pitting of the metal due to over timing

WASTE HEAT BOILER

Operates on Exhaust of Diesel Or on Household Oil Burner

Self-contained and compact, an exhaust waste heat boiler of new design is enclosed in an insulated steel cabinet only six feet, six inches long, seven feet, six inches high, and three feet, two inches wide The unit functions automatically on exhaust gases from a turbocharged Diesel engine, or it can be operated by a household type oil burner

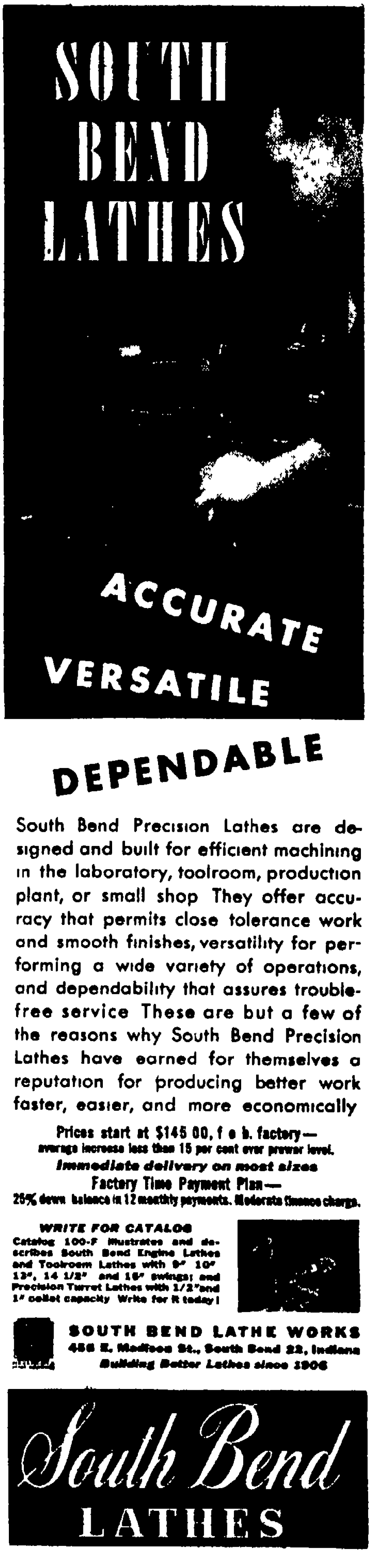
The waste heat boiler generates 500 pounds of steam per hour on the Diesel exhaust and considerably in excess of that figure when operating on the oil burner

Exhaust gases at 600 to 800 degrees, Fahrenheit, coming from the Diesel engine run the unit as long as the engine functions When the engine is shut down, the oil burner is cut in by a few simple steps, so that there is almost no interruption in the boiler's operation, and no break at all in the heating service When no heat is required, the boiler can be run dry, acting as a muffler to the Diesel engine

Oil burner in bottom of housing is used when Diesel is not operating

The new waste heat boiler, developed by the American Locomotive Company, features strict safety precautions When the engine is operating, the oil burner in the boiler cannot be turned on accidentally The oil burner combustion chamber is lined with refractory at the plant

The compact unit is shipped ready to



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Training of this kind is provided by the Modern Business Course and Service of the Alexander Hamilton Institute The Course covers the four major functions of business—Production, Marketing, Finance and Accounting It turns out not accountants, or salesmen or production men, but *executives!*

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Many prominent contributors

One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors Among them are such men as Thomas J Watson, President, International Business Machines Corp, Frederick W Pickard, Vice President and Director, E I du Pont de Nemours & Co, Clifton Slusser, Vice President, Goodyear Tire & Rubber Co., and Herman Steinkraus, President, Bridgeport Brass Company

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operate All that is necessary is to connect it to the gas exhaust, hook up water and oil lines, and plug in the current

A wide range of application for the new waste heat boiler is seen, not only for product pipelines and central power stations but in all industries using Diesel engines where the unit can be applied profitably for heating on limited amounts of process steam

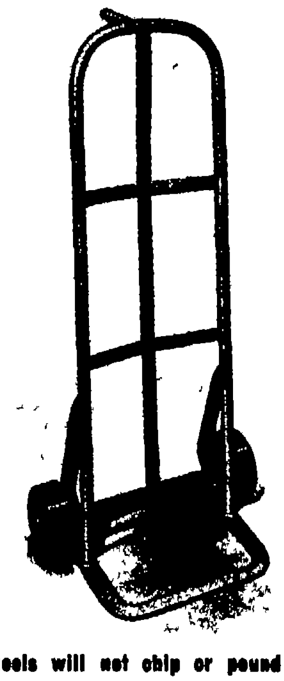
PLASTICS-CANVAS WHEELS

Reduces Floor Wear, Can-Not Create Sparks

Composed of phenol formaldehyde resin and macerated duck canvas, plastics truck wheels possess excellent floor protective and shock-resilient qualities They roll easily under heavy loads and their resistance to oil, mild acids, and temperatures varying from zero to 100 degrees, Fahrenheit, (inherent properties of the Durez resin used) make them well suited to numerous industrial uses under widely varying conditions

Floor maintenance costs are kept down when industrial trucks, whose wheels formerly pounded and chipped

Section of plastics-canvas wheel



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Removes Scale and Rust By Electrolysis

CONTROLLING electrolysis, removing scale, and preventing its formation in hot water heaters of all kinds, a new electrolytic device consists of a number of zinc and copper plates mounted in series When submerged in the water, this combination sets up an electromotive force in the hot water heater which, it is claimed, renders the salts and minerals inert, at the same time removing scale and preventing corrosion Easy to install, this treater is inserted at the hot water outlet and suspended in the water Known as the McRay Treater, this device is said to require a minimum of attention after installation, and in every case where it was used, it not only removed scale from the hot water tank, but also from the pipes fed by the tank Regular size for household use has a capacity of 300 gallons of water per day, and larger types are also available

Cutaway view shows treater (at left) suspended at the hot water outlet

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THE SIMPLEST BUSINESS SYSTEM. This 20-page booklet describes the technique of Ozalid printing, pointing out how it can save time, labor, and dollars in any average business office With this method a positive copy can be made directly from any translucent paper or card in 25 seconds *Ozalid, Division of General Aniline and Film Corporation, Johnson City, New York —Gratis*

NEW PROTECTION AGAINST AIRBORNE DISEASE is a four-page folder illustrating and describing five new models of commercial germicidal units which are said to utilize potent ultra-violet radiation to kill airborne germs, viruses, and mold-forming spores These units are available in wall-type and portable models *Lustra Corporation of America, 40 West 25th Street, New York 10, New York —Gratis*

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Minerals, Rocks, and Soils This 44-page catalog lists types and prices of specimens available for research purposes and classroom use All specimens are accompanied by appropriate labels and printed information Request Catalog No 474 *Ward's Natural Science Establishment, P O Box 24, Beechwood Station, Rochester 9, New York—Gratis*

A Presentation of Welding and Cutting Equipment Presented in this 20-page catalog are descriptions, specifications, and prices of various gas welding and flame cutting apparatus *Victor Equipment Company, 844 Folsom Street, San Francisco 7, California.—Gratis*

DC Anti-Foam A, a four-page folder, describes this silicone compound used for killing foam in aqueous systems including steam distillation and vacuum evaporation, laboratory distillations, and analytical procedures In addition to outlining the physical properties of the anti-foam agent, this folder covers the methods for using it and gives a list of the industries which will find it useful *Dow Corning Corporation, Midland, Michigan—Gratis*

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Wisdom is not readily attainable by the general public, nor recognized when right within reach The average person absorbs a multitude of details about things, but goes through life without ever knowing where and how to acquire mastery of the fundamentals of the inner mind—that mysterious silent something which "whispers" to you from within

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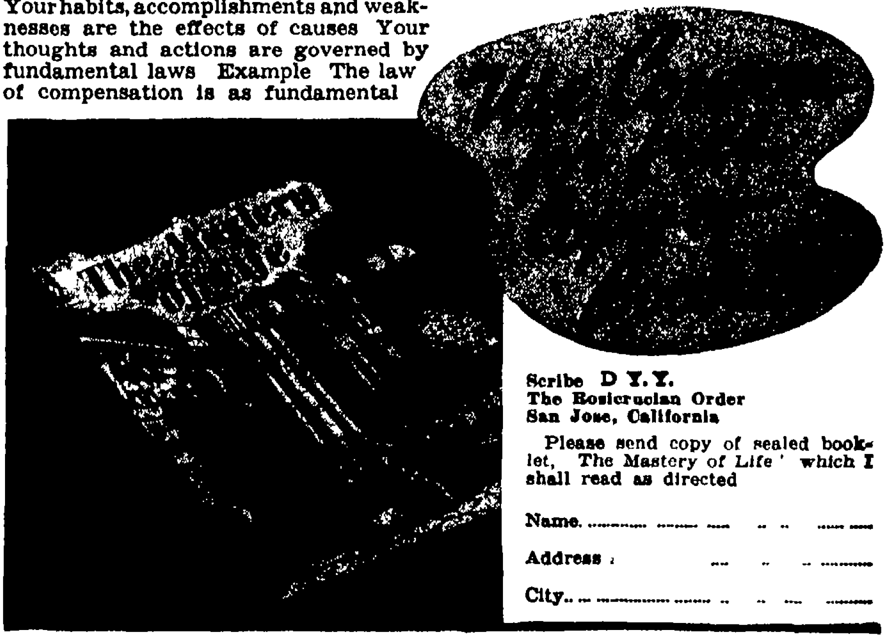

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COMBAT SCIENTISTS

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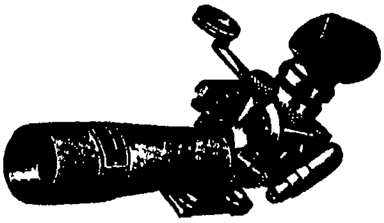

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RUSSELL PORTER, at last getting some earned rest at 75, has become a TN again and sends the fraternity the following, via this department

"The accompanying drawings (Figure 1) show an attempt to erect the image of an objective by means of mirrors instead of the two Porro prisms almost universally used today in binoculars The four mirrors *a*, *b*, *c*, and *d*, are flat and aluminized. The axial paths of the objectives, *o*, are shown dash-dotted in all four views, and the marginal lines of the cone from objective to its focus are full lines

"Mirror *a* receives the incoming light and reflects it upward at 45° (the normal to its surface being at 22½° to the axial ray) Mirrors *b* and *c* are really parts of surfaces at right angles to each other, their intersections being parallel to the incoming and outgoing axial rays I have shown *b* and *c* as elliptical in outline only to show more clearly the areas cut by the narrowing cone of light. Finally, the cone goes from *c* to *d* and thence to the focus The normal to *d* is also at 22½° to the axial ray

"By referring to the plan view one may see that the light path from *b* to *c* is not at right angles to the main axial rays, but makes an angle of 45° to them

"I have made two or three of these telescopes—one a binocular—and find that they perform very well The light loss through reflection is comparable to the reflecting and absorption losses in Porro prisms Unquestionably, their manufacture and adjustments are more complicated than when Porros are used But the light paths, being entirely through air (they cross each other several times on their way to the focus) render the telescope extremely short For example, in the one shown in the diagrams, where the focal length of the objective is about 8", the length of the housing comes out only 3", hence it is very compact.

"I do not know whether this method has been tried out before I worked this out myself some ten years ago"

SOME who try to build their final telescope first put much hard work on instruments they often wish were different but the telescope shown in Figures 2 and 3, made by Fred Larsen, 638 West 110 St., Los Angeles, Calif, when closely studied, looks more than most like a third-job design on a first-job instrument Good judgment with regard to various details appears to have been used It is partly a machine-tool job but is not over-elaborated Let's look it over.

Pedestal Much more than mechanically adequate but esthetically just right However, if looks don't mean a thing, as some claim, then perch a big telescope atop a mechanically adequate 2" or 3" post where it will look as if "all top" Posts are pretty cheap Why skimp?

Drive If there is to be one at all and unless photography is to be done, why must a drive be highly precise? Larsen's will keep an object in the field of view as long as most observers care to look It is a simple sewing machine motor with an electric governor of the type used in movie projectors If the telescope moves too fast one of the switch knobs at the end of the wire in Figure 3 will start it moving slowly

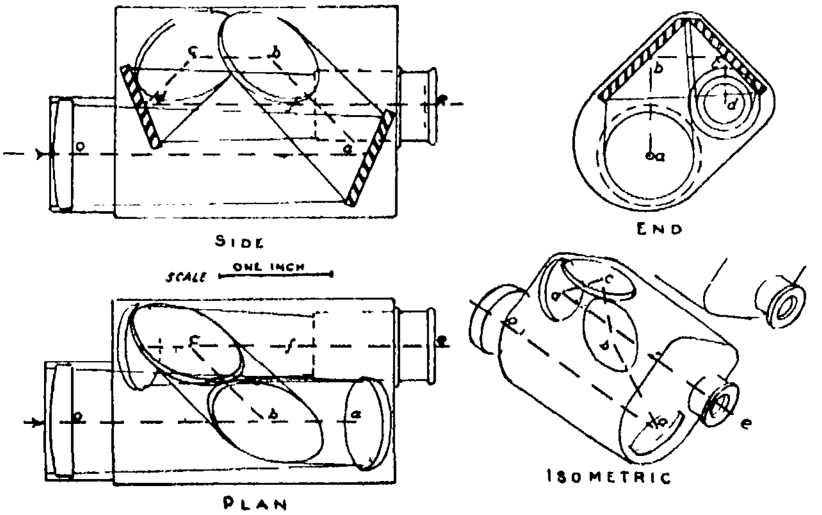

Figure 1: Porter's experiment with mirror erecting systems

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Drive gear An 185-tooth worm gear cut with a 1" tap ("A T.M.A," p 365) It came out very well, Larsen says

Bearings Tapered and therefore without play and solid.

Setting circles Laid out on a lathe, using some of the thread-cutting gears held with an improvised ratchet to divide them

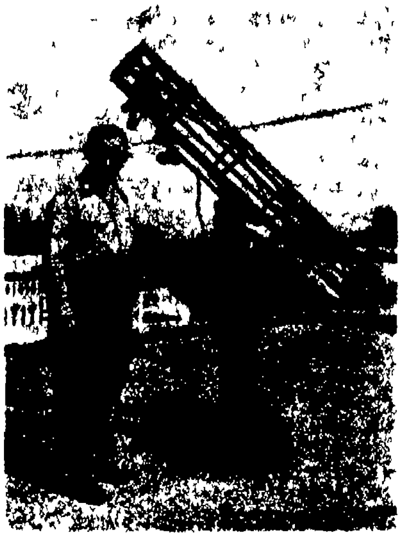

Figure 2: Larsen and telescope

Tube Metal, skeleton Tube has a rotating head, the heavier ring near the top is actually two rings, the upper rotating on the lower "This," Larsen writes, "is *very* useful but must be accurately and rigidly made, else it will not stay collimated well" Such rings wring no necks, a big comfort.

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Polarizing diagonal Three flat mirrors the size of the telescope diagonal, set at 57° critical angle Rotate to vary sunlight. Removable

Site Flat-top residence roof Pier shown rests on crossing of wooden partitions below It has proved solid and walking below does not shake it.

"To have spent many hours of spare time building this telescope has been one of the most gratifying experiences I have ever had," Larsen writes. "It has given me a little of the feeling that must come to an artist after he has finished a painting, one feels satisfied when anyone shows interest in his workmanship, and the ego shows signs of inflation.

"Thirty years ago in the land of the great Tycko Brahe and Ole Roemer," he continues, "I came upon a description of a homemade telescope, a 3"

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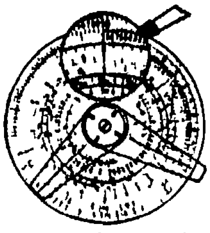

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made in the usual manner except that it did not mention the all-important Foucault test, described in 'ATM' Carbo and rouge did not grow on any of the plants my father raised, but years later I became again infected by the *Bacillus telescopia* and have had the fever ever since"

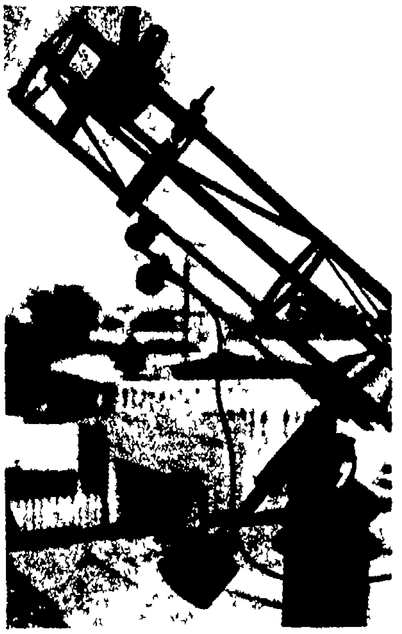

Figure 3: "Teeke Bry" would envy

In describing Larsen's telescope pedestal this department characterized it as esthetically just right Subsequently, two photographs of even fatter pedestals were found among old files, and these, the first by W W McClure, Grosse Pointe, Mich, the second by Ralph Munn, Pittsfield, Mass, seem even more pleasing though individual tastes in legs differ Not wishing to single out any example of the opposite kind—spindly—we forbear from illustrating this extreme, but examples are numerous

Figure 4: A study in pedestals

How Dr Anderson tests the 200" mirror is explained by Porter "Over the mirror he places a diaphram with a series of 5" holes 6" apart across a horizontal diameter The knife-edge and light source are at the c of c of the mirror about 110' away Starting from zero in the center, each pair of holes is numbered—1, 2, 3, and so on, to right, same to left.

With the knife-edge at *A* (Figure 5)

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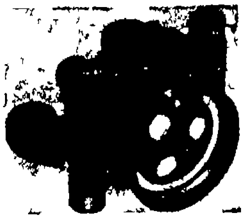

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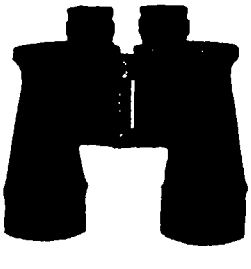

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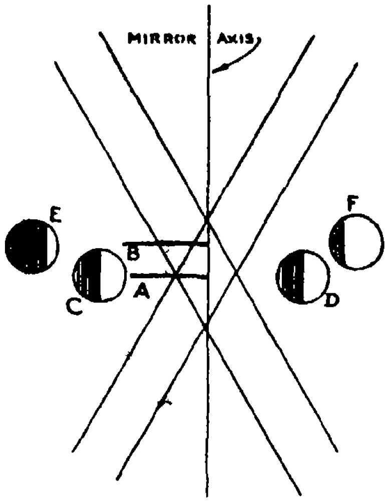
the two holes (windows) will appear as at *C* and *D*, half darkened. The knife-edge is moved along the mirror axis until this condition is found If the knife-edge is not where it should be, at *A*, but is at *B*, you will get the shadows shown at *E* and *F* and the knife-edge is accordingly moved back to *A*

The radius of curvature for each pair of holes has been computed and thus any departures of *A* can be determined



Drawing by R. W Porter
Figure 5: The Andersen test

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In addition to this, the mirror is rotated to detect any astigmatism

Recently several amateurs were asked how they would vote to use 16" blanks Walter Houston, Cincinnati, voted for an *f*/7 Newtonian, H E Bussey, Atlanta voted for an *f*/8 or *f*/9 Newtonian, G P Arnold, Chicago favored an *f*/8 Newtonian Your vote?

Perhaps Vicksburg's express agent will never be a TN Mrs Nona Ledbetter of that community, who is, says a local TN wanted to ship a mirror to be aluminized but, fearing breakage, spent half an hour explaining the whole art, to impress the gentleman He listened politely, looked puzzled, hesitated, wrote on the waybill "1 pc glass, value $50"

New life for planetary and lunar observation among amateurs in America is promised by the inception of a monthly periodical, "The Strolling Astronomer," edited by the generally recognized leader of this activity, Walter H Haas of the Institute of Meteoritics at the University of New Mexico, Albuquerque, N M It starts off with 50 subscribers and in mimeographed form Amateurs interested in lunar and planetary observation now will gather around Haas and through this organ work out ways to end the existing situation in which each separated individual goes it alone, which is less fun than going it together

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ON THE COVER: Bottles of atmospheric gases under high pressure awaiting delivery from the Philadelphia plant of the Air Reduction Company For story, see page 245

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50 Years Ago in . . .

(Condensed from Issues of December, 1897)

TURBINIA — "If the compound steam turbine fulfills its present promise, it is likely that in certain branches of engineering it will hold absolute possession before many years have passed The present year has seen the advent of a phenomenal little boat, the *Turbinia* Steam turbines of the type designed by Mr Parsons, son of Lord Rosse of telescope fame, were submitted for the ordinary reciprocating type of engine, and by driving them at a speed of 2,100 revolutions per minute, 1,576 horse power was realized from an engine weighing only 4 1/10 tons, or 5 1/10 pounds per horse power It now remains for someone to make as big a reduction in boiler weights as Mr Parsons has in engine weights A small and compact boiler capable of instantly generating 1,000 pound steam from small quantities of water supplied to it as required would be the logical counterpart of the turbine running at 2,000 revolutions per minute and expanding the steam to zero, which is what the Parsons triple expansion turbine now accomplishes"

YEAR OF PLENTY — "The yield of winter wheat in Kansas is fifty million bushels, worth thirty-four million dollars, or 160 per cent more than last year The corn crop totals one hundred and fifty-one million bushels, and the yield of oats is twenty-three million bushels, the two together bringing in thirty-two million dollars This is the record of a year of plenty In the presence of such figures one is prepared to believe there may be more truth than jest in the statement that Kansas will 'forward a car load of canceled mortgages' to the forthcoming exposition at Omaha as a token of her returning prosperity"

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TUBE TECHNOLOGY — At the McKeesport works of the National Tube Company flanges are now welded on pipes up to 30 inches in diameter The job is as perfect as the lap weld in the pipe itself The flange is pushed on over the end of the pipe, which is then beaded over with a few taps of the sledge hammer to keep the flange from coming off in the furnace The latter, as shown in the engraving, is gas fired and built in two semi-circular halves, the upper of which is removable When the work has been raised to welding heat, the top half of the furnace is raised, and the pipe is swung on to a concave anvil, which is stepped to receive both pipe and flange An L-shaped hammer is struck against the interior surface of the pipe and as pipe and flange are turned round on the anvil the welding up is quickly completed."

NO PEARLS — "The municipal authorities of Paris are just now engaged in the suppression of an altogether novel form of food adulteration Artificial oysters on the half shell have been invented, and they are so cleverly made that once lemon juice or vinegar has been added, they cannot be distinguished from the real article, especially when white wine is taken in connection therewith The only genuine thing about these oysters is the shell, the manufacturers buying second-hand shells at a small cost The municipal laboratory has not yet proclaimed the ingredients of which these bogus oysters are composed, but has announced that they are of a harmful character"

FEATHER EVIL — "When a lovely woman stoops to folly, she stoops very low indeed Consequently, it is not likely that the insensate votaries of fashion, who disfigure their heads with unnaturally clipped or colored bird feathers, will pay any attention to a paragraph in a scientific journal The rate at which some of the rarest and most beautiful birds on our planet are being destroyed to gratify this extraordinary taste can hardly be realized On the 13th of April last nearly half a million birds were sold at an auction in London It is small consolation to us to think that in a few years the price of these luxuries will be prohibitive or that unless fashion changes in the direction of seaweeds or turnip tops, there will soon be no more birds to destroy"

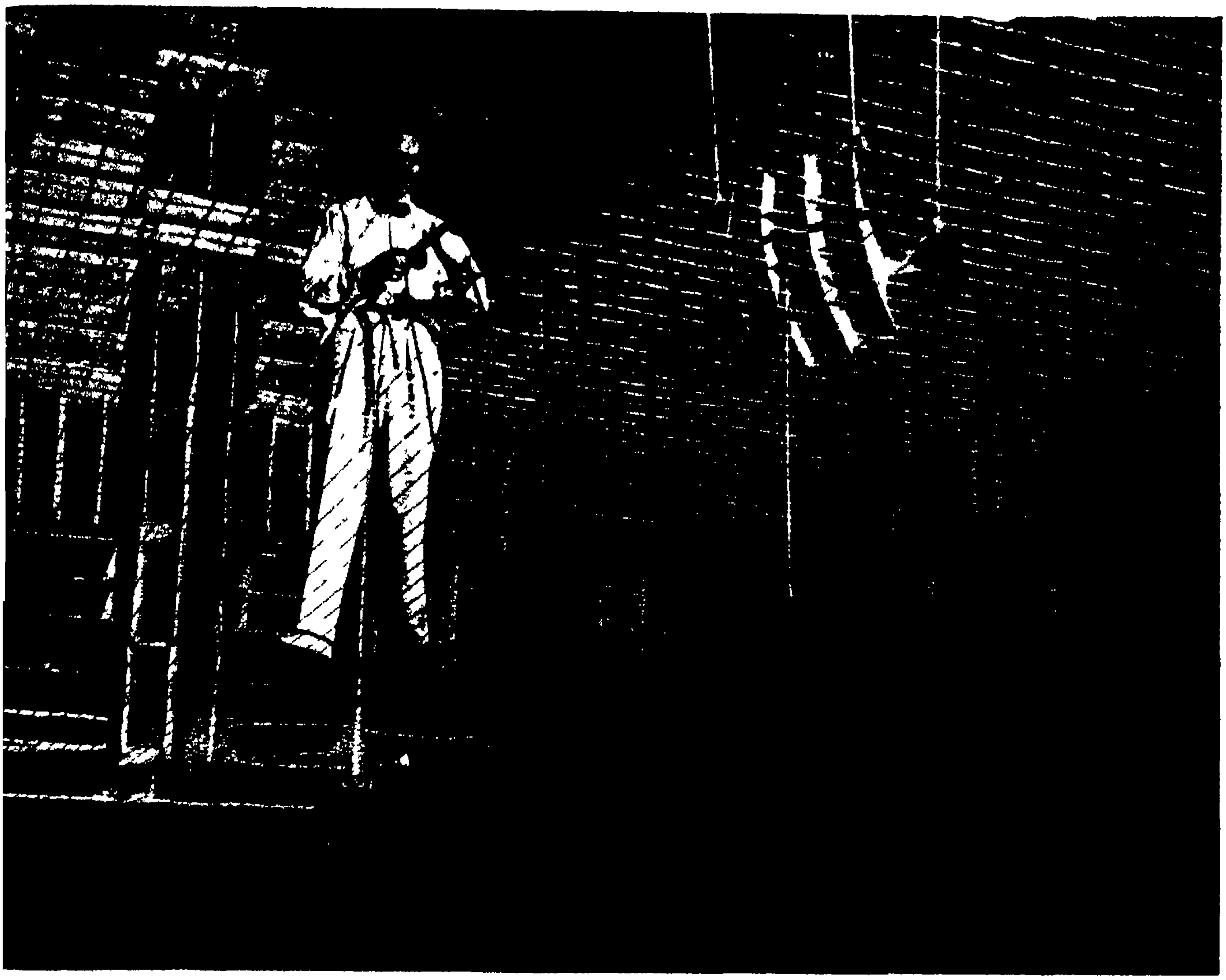
100 Years Ago in . . .

(Condensed from Issues of December, 1847)

ALLADIN'S PALACE — "The Capitol at Washington is now perhaps the best illuminated building in the world The Senate Chamber and House look like a scene in Alladin's palace Above the dome of the Rotunda, towers the great lantern filled with burners, and the chandeliers of both houses are superb Each chandelier furnishes light equal to 5000 spermaceti candles The lighting of the chamber is complete, enabling anyone to read with perfect ease on any part of the floor, and the light though so powerful, is yet so soft that it is delightful to the eye"

SCOUNDREL — "Only that some scoundrel cut the telegraph wires on Tuesday morning, the whole of the President's Message would have been circulated in our city printed in full on that evening As it was we had it in full early Wednesday morning The electric telegraph has made thought almost omnipresent It is a most wonderful and invaluable invention"

ACCELERATING PROGRESS — "The field for the chemist yet to explore, is still as boundless as imagination can conjecture Before 1809 the number of metals known was only twenty-seven, and ten of these has been ascertained in twenty years previous, as many as were discovered during all the middle ages, the ancients knowing only seven, which were compared to the notes of music in the gamut, the number of plants and the color of the rainbow, giving rise to many superstitions We now know forty-four metals and ten times more acids than the ancients did, and the end is not yet"



A telephone listens to a loud speaker in the new "free field" acoustic test room at Bell Telephone Laboratories. The sound transparent "floor" is built of steel cables.

Test-tube for Sound

This giant "test-tube" is actually an echoless sound room at Bell Telephone Laboratories. Here engineers seek new facts about sound which will help them make telephone service still better and more dependable.

Bell scientists know a great deal about what happens to sound in electrical systems. This new room will give them a powerful tool to find out more about what happens to sound in the air.

In an ordinary living room, most of the sound addressed to you comes by way of reflections. At 10 feet less than 10% reaches you directly.

Sound that *bounces* at you from walls, ceilings, furniture, and your body is all right for hearing—but it poses questions for scientists who would study it uncontaminated by reflections.

The Bell Laboratories' "test-tube" gives telephone people the chance to produce pure sound and analyze it reliably with respect to intensity, pitch, and direction. The entire room is lined with glass wool, contained in wire-mesh cases, wedge-shaped to give maximum absorbing area. Sound bounces along the sloping surfaces, sifts into the soft glass wool, and is gradually stifled.

This is one more example of Bell Laboratories' constant work to learn more about everything which can extend and improve telephone service.

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AN ANNOUNCEMENT TO OUR READERS

It is sometimes recalled on these pages that the Scientific American was founded in 1845. The intervening century has been a time of profound change for science and the Scientific American.

When the first issue of the Scientific American was published the principal meaning of science was the use of good sense and mechanical ingenuity to improve the convenience of man's daily life Under the direction of its great editor Orson Desaix Munn, the Scientific American reflected this meaning of science with authority and dignity It reported the inventions of men like Samuel F B Morse and Thomas Edison and the application of their works to the geographical and industrial expansion of the U S Today the Scientific American carries on in this journalistic tradition of reporting the practical applications of science, notably in industry

In more recent years, the Scientific American has often observed, science has acquired a larger meaning than in the elder Mr Munn's day Applied science can no longer be held separate from fundamental science—the pursuit of knowledge about the physical world without immediate regard to its application During the past 50 years, fundamental science has become a central enterprise of civilization It has moved forward at an accelerating rate, with each discovery opening the way for others It has given the applied sciences command of natural phenomena which are far outside man's daily experience Whole industries are founded today in provinces of knowledge which yesterday were occupied by the advance forces of fundamental science The enterprise of science has assumed an identity with man's aspirations to material and social progress. Recognizing this, responsible citizens have stated their need for information about all of science, fundamental as well as applied.

The Scientific American has accepted this obligation of modern science journalism To meet it, the magazine is currently entering a period of change. Orson D Munn, the present editor and grandson of the elder Mr Munn, has addressed the following message to the readers of the Scientific American

"The Scientific American, which has been owned and published by my family since its second year, has been purchased by a new publishing company With this issue I am retiring as editor to devote all my time to the practice of law. I will, however, remain a stockholder in the new Scientific American"

Under a new board of editors, the editorial content of the Scientific American will also change The new Scientific American will report the development of all branches of science the physical, biological and social sciences, as well as their more significant applications in medicine, engineering and industry The new Scientific American will be addressed to the growing community of U S citizens who have a responsible interest in the advance and application of science Among these are the scientists themselves, the doctors and engineers, the executives and managers of industry and those engaged in the non-technical professions of teaching and the law The common denominator of this audience is the interested layman the scientific professional, who is a layman in departments of science outside his own, and all others who recognize the bearing of science upon the welfare of themselves and their fellow men.

The new Scientific American will solicit articles by scientists Recognizing, however, that the main business of scientists is science, it will obtain most of its articles from its own staff, journalists whose life work is the reporting of science The editors of the Scientific American must develop a new creative process in science journalism At every stage in the production of their articles, they will work in close collaboration with the men whose work they will report. The finished product will be the result of a joint effort, the scientist providing the substance of what is reported and the journalist the art of clear communication

The new Scientific American will place a large emphasis on the use of the graphic arts. Where its written vocabulary proves inadequate, the Scientific American will employ pictures to communicate the ideas of science precisely and plainly The magazine will utilize the full range of graphic art. photographs, paintings, drawings, charts, diagrams, maps.

All of these changes will take time. The earliest possible date by which they can be assembled in the new Scientific American will be in the spring of next year. Until then, therefore, the Scientific American will continue its important work of reporting progress in industry.

6 JAN 948

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DECEMBER • 1947

INDUSTRIAL GASES

Tools and Materials In Steel Bottles

All illustrations courtesy Air Reduction Company

The oxyacetylene torch, one of the basic tools of industry, slices easily and quickly through tough steel

EVERY time we turn on an electric light, listen to a radio, use a telephone, open a can of food, or take a bath, we are benefitting either directly or indirectly from the commercial application of one or more of the industrial gases

There is hardly a product of industry which has not, either in its own manufacture, or in the making of the tools and machines which produced it, gained something of quality, economy, or efficiency from at least one of the industrial gases

These industrial gases can be said to fall into two general groups—those obtained from the atmosphere—oxygen, nitrogen, helium, hydrogen, neon, argon, kripton, and xenon—and those produced from other sources—acetylene, chlorine, and carbon dioxide (those gases used exclusively as fuels are not included in this article)

ATMOSPHERIC GASES — If we were to reach into the atmosphere, take out a cubic foot of pure air, and break it down into its various components, we would find that it contained a little more that 78 percent nitrogen, almost 21 percent oxygen, a little less than one percent argon, and infinitesimal amounts of hydrogen, helium, neon, krypton, and xenon

In order to separate these various atmospheric gases, and get them in usable form, the process known as "air reduction" comes into play In this process, the air is compressed, purified, liquefied The gases are then separated by fractional distillation as the liquid air is allowed to rise in temperature

High-Purity Oxygen The most familiar of the industrial gases is oxygen. About 30 years ago the commercial production of oxygen from the atmosphere became a reality, and the oxygen industry was born

The constantly rising production figures for oxygen, and its declining price over the last 25 years indicate the growth of this new industry In 1920, for example,

Linlithgow Library
Imperial Agricultural [illegible]

the United States produced about one billion cubic feet of oxygen Present production is running at an annual rate of some 14 billion cubic feet During this period, the average price of the gas has dropped about 60 percent The most widely known industrial use of high-purity oxygen (99 5 percent pure) is in the oxyacetylene processes for cutting and welding metals When mixed with acetylene, oxygen makes possible flame temperatures in excess of 4000 degrees, Centigrade It is this intense heat which has made the oxyacetylene cutting and welding torch one of the basic tools of industry

High-purity oxygen also is used extensively in the medical field, the principal application being for inhalation in cases of pneumonia, polio, and heart conditions In aviation, the gas is an essential for high-altitude flying Without oxygen inhalators or "pressurized cabins," pilots and passengers would "black out" at the upper levels of the atmosphere

***Low-Purity* Oxygen** There are still new uses for oxygen to come out of the laboratory War-time economy in Germany led to the use of oxygen as a means of accelerating steel production, and for the synthesis of gasoline from brown coal The high-purity oxygen required for the oxyacetylene flame and for therapy, is not necessary for these new industrial uses A less pure, and consequently a less expensive type of gas (85 to 95 percent pure) has been found quite satisfactory

• LOOKING AHEAD •

Great expansion of industrial gas producing facilities Higher quality steels produced far more rapidly More effective packing of perishables Research bringing new uses and markets for the industrial gases

A greater volume of acetylene is used as a raw material for such synthetics as this neophrene, than is consumed by all of the illuminating and welding applications combined

In considering low-purity oxygen, we are considering a new product for new markets Recently, the American steel industry has joined with the industrial gas industry in exploring the use of oxygen in the steel furnace, both for fuel combustion and for refining of the metal Oxygen-enriched oil flames have brought appreciable savings in steel production time And experiments in the injection of oxygen directly into the furnace to reduce the carbon content, indicate additional savings in production time and improved quality of the product

Nitrogen Unlike the highly active oxygen, nitrogen is a nearly inert gas Because of this comparative inertness, nitrogen is valuable as a "guardian" in many industrial applications where it protects against such chemical reactions as oxidation Typical applications are electrical transformers, telephone cable conduits, and food containers

One of the most promising uses of the very abundant nitrogen is in the protection of special, high-quality steels and other metals during high-temperature furnace treatment The nitrogen gas is injected into the furnace "atmosphere" to prevent damaging effects which otherwise might occur during the high-temperature heating process

Nitrogen also serves as a guardian in the production of nylon fiber, protecting the synthetic material from oxidation at the crucial stage of forming the fiber itself Another application of this gas is found in the so-called vacuum-packing of foodstuffs Here nitrogen is injected into the container, driving off the oxidizing atmosphere, and leaving the contents under a protective envelope of inert gas

With a steady trend toward greater efficiency in packaging and toward more precise quality standards in manufacturing operations, the present uses of this inert gas may be sign-posts to a far wider range of protective functions

Rare Gases The rare gases of the atmosphere—neon, krypton, xenon, and argon—are characterized by complete chemical inertness, and by the fact that, when subjected to sufficient voltage they emit a bright glow, the color of which varies with the type of gas

Argon is used in large quantities in electric light bulbs, where its inertness protects the filament from burning up, thus prolonging the life of the bulb Use of this gas also permits a more efficient lamp, which delivers more light for a given current consumption

Although neon has given tubular display signs their most popular name, the "neon" signs which identify and advertise almost every kind of business and product are, as often as not, filled with other rare gases, or with mixtures of neon with other gases

While a wide range of colors can be obtained in tubular displays by coloring the glass, it is only through the use of mixtures of these rare gases that the complete range of eye-arresting colors is possible

In less spectacular but perhaps more important uses, the electrical qualities of the rare gases make possible many of the miracles performed by electronic tubes, stroboscopic and high-speed flash-lighting, and other highly specialized devices of modern science and engineering

Helium and Hydrogen Although they are present in the atmosphere, helium and hydrogen can be produced more economically through other means than air reduction

The oxyacetylene flame cleaning torch equipped with a multiplying tip rapidly strips paint, dirt, and rust from the ship's hull

Helium is found in the gases of certain natural gas wells, and it is from this source that most of this inert, colorless gas is produced

An important use of helium is in the medical field, where it is employed with oxygen in treating the "bends," suffered by sea-divers and tunnel-digging "sand hogs" Of course, a more familiar use of helium is as the buoyant filler for lighter-than-air craft In industry, helium plays an important role as a "shielding gas" in the Heliwelding process, to protect stainless steel, aluminum, and other metals from oxidation during welding

Hydrogen is obtained largely by separating water into its components by electrolysis It is used in combination with an electric arc in the welding of hard-to-weld alloys, where extremely high temperatures are required (see Scientific American, page 137, March 1947) Hydrogen is also used in the production of synthetic ammonia, and as a cooling atmosphere in high-speed turbo-generators and similar electrical equipment In the food industry, it is used in the production of the improved vegetable shortenings

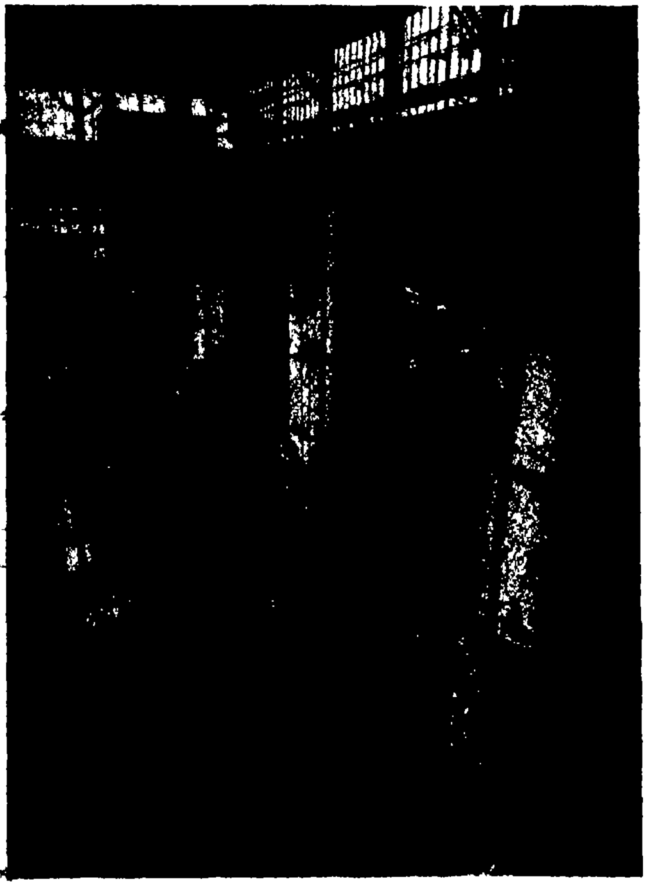
NON-ATMOSPHERIC GASES — The other gases which the industrial gas industry provides for American business are those produced from sources other than the atmosphere

Acetylene There have been many ups and downs in the uses of acetylene since it emerged from the class of laboratory-made materials And there is a good prospect for even more sweeping changes in the future

Actually, acetylene was discovered in 1856, but it was not until 60 years later that production methods became suitable for manufacturing it in commercial quantities Carbide, from which acetylene gas is derived, is known chemically as calcium carbide and is formed by the fusion at very high temperature of calcium oxide (lime) with carbon or coke When carbide comes into contact with water, a chemical reaction takes place and a gas is produced This gas is acetylene

Before the era of the electric lamp, acetylene provided much of the nation's lighting There were carbide lamps in homes and on the early "horseless carriages As technological progress brought the electric lamp into the home and placed electric headlights on automobiles the use of acetylene diminished

High purity oxygen, separated from liquid air by fractional distillation, is produced for welding or inhalation in such air reduction plants



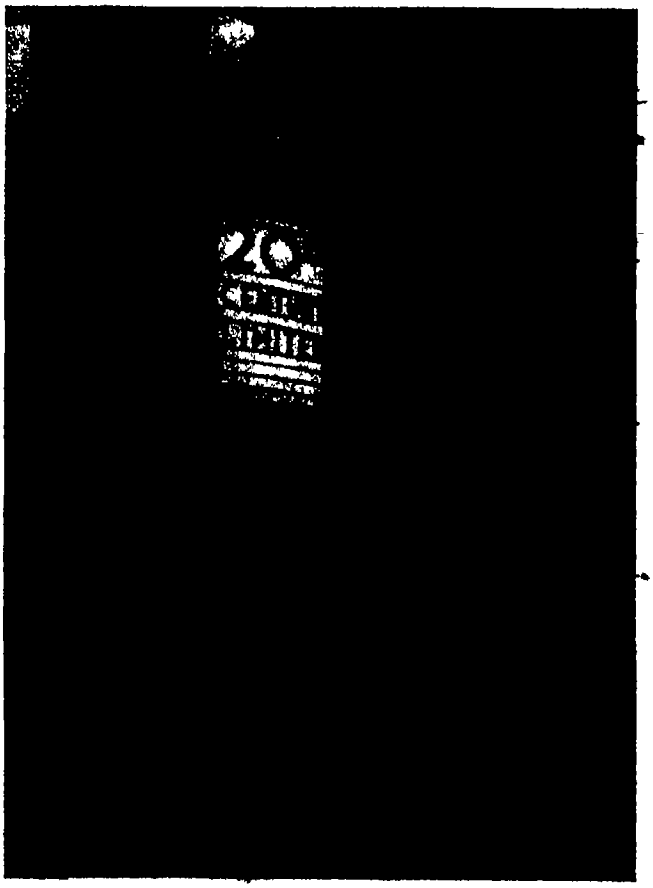
rapidly. But the very technological progress that closed one door to the use of acetylene, opened another, which has led to far more important fields.

The production of many mechanical devices such as automobiles made new manufacturing techniques imperative. Wood, molded metal products, and other construction materials did not have the mechanical strength or durability required in the new machine age. Steel in many instances was the material used, but its fabrication was slow and costly. The very strength that made it desirable rendered it difficult to cut and shape. Riveting or bolting was the accepted method of joining pieces, but such joints slowed the making of assemblies, and added to the over-all weight. To solve this problem a new tool was introduced—the oxyacetylene flame. This flame heats metals to temperatures higher than their melting points, providing a practical means of cutting and shaping varied thicknesses to intricate forms.

Spectacular as the oxyacetylene flame and the work accomplished by it may seem, the role of acetylene as a starting point in organic chemistry gives indication of being even more important. Today, more acetylene is used as a chemical raw material than as a fuel gas. In this connection, acetylene is now used in the production of various synthetics, including neoprene, koroseal, acetate rayon, and chlorinated solvents.

It will take time to show where acetylene will reach its greatest importance, but the future of this gas looks bright.

Although acetylene lighting has disappeared from the home and the automobile, it is still widely used for many types of hand lanterns



Chlorine. One of the two elements in common salt, when released from that compound, is a yellow-green gas having a pronounced choking effect if breathed in any quantities. This is chlorine, an industrial gas of great importance.

Over a million tons of chlorine are used each year. The gas is produced by passing an electric current through a purified solution of common salt. On so doing, chlorine is released at one electrode, while sodium is freed at the other. The chlorine is used directly from the electrolytic cells in some processes, and for others it is dried, refrigerated, compressed into cylinders or tank cars, and then used as required. Chlorine has a powerful bleaching action, and is employed extensively in the bleaching of paper pulp, jute, linen, and cotton. It is also used to purify municipal water supplies where it destroys bacteria. A similar use is that of reducing fungus or marine growths in the raw water supplies of electric power generating stations.

Many of the compounds of chlorine are well known to the public. For instance, there are the insecticides, DDT and hexachlorobenzene, the solvents, carbon tetrachloride, trichloroethylene, perchoroethylene, and ethylene dichloride, and such miscellaneous chemicals as chloroform. The list of uses of chlorine is an uncommonly long one, for the gas is quite reactive.

Carbon Dioxide. The third non-atmospheric industrial gas here discussed—carbon dioxide—is well known by the general public because of its use in carbonated beverages, for fire fighting, and as a refrigerant in the form of "Dry-Ice."

Carbon dioxide, a colorless, odorless gas, is the most common oxide of carbon, and is one of the products of combustion of all carbon compounds.

Although carbon dioxide was first identified as a gas about 1800, it was not produced commercially until 1887. The gas was then obtained principally from the chemical reaction of sulfuric acid and marble dust—limestone—and by extraction from natural carbonated water. These sources were later superseded by the production of carbon dioxide from combustion processes—calcining limestone, burning of coke and other carbonaceous fuels—and from alcohol fermentation.

Solid carbon dioxide, better known as "Dry-Ice," was first produced on a commercial scale in 1925. Up to that time practically the entire carbon dioxide supply was used in the manufacture of carbonated beverages. The introduction of "Dry-Ice" resulted in improved methods of food distribution and in the development of numerous new industrial applications.

The history of the industrial gas industry is comparatively short. But in the time since the first industrial gas became available commercially, the industry has become an essential one. It has helped all American industry to improve the quality of its products, cut production time, and reduce operating costs. Furthermore, without industrial gases, many of today's products could not even exist.

The industrial gas industry recognizes its important position, and is actively engaged in research in new uses for its products, and in expanding manufacturing facilities in an attempt to keep up with the ever-increasing demand.

SODIUM CHLORITE Goes Commercial

By Dr. G. P. Vincent
Technical Director,
The Mathieson Alkali Works, Inc

Despite the Fact That Sodium Chlorite Emerged Only Recently From the Experimental Laboratory, It Already Has Become an Important Commercial Chemical With New Speed and Efficiency It is Handling Many Tough Bleaching and Deodorizing Tasks Throughout All Industry

Sodium chlorite, chemically speaking, is nothing more than common table salt to whose chlorine atom two oxygen atoms are attached And it is these two atoms of oxygen, clinging to each chlorine atom, that hold the secret of sodium chlorite's success as an industrial chemical of ever-increasing importance These oxygen atoms, acting with the chlorine atom, provide a highly effective oxidizing agent whose bleaching and deodorizing capabilities are two and one-half times greater than those of chlorine alone And equally important, this oxygen-chlorine combination is responsible for sodium chlorite's unusual "selective oxidizing" ability (the ability to oxidize some materials without disturbing others) In addition, should the oxygen and chlorine be wanted alone, in a gaseous state (as required for water purifying or fat bleaching, for example), sodium chlorite provides a convenient source of the highly reactive chlorine dioxide gas

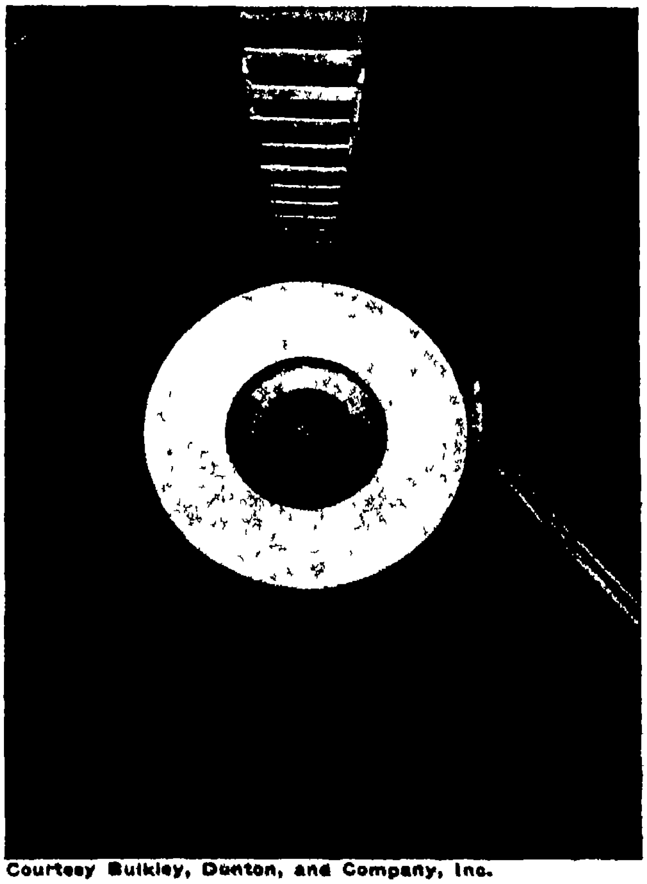
Despite the fact that sodium chlorite was identified as long ago as 1843, its use, until quite recently, has been limited to laboratory experimentation, because no practical method could be found for manufacturing the chemical on a commercial scale Extensive research, however, finally led to the development of a successful large-scale manufacturing process, and sodium chlorite became available in commercial quantities just before the second World War

BLEACHES PAPER TEXTILES — The chlorine compound most widely used for bleaching cellulose materials, such as wood pulp or many textiles, has been hypochlorite However, hypochlorite is not entirely satisfactory for certain purposes

When cotton goods or rayon is bleached with hypochlorite, a product known as oxycellulose tends to form This weakens the fiber and causes reversion of color or "yellowing" on storage, and uneven dyeing Although the amount of oxycellulose produced in bleaching cotton goods can be kept to a minimum by careful control of the bleaching process, especially by preventing it from progressing too far, some oxycellulose is almost inevitably formed.

When sodium chlorite is used, the oxygen in the compound destroys the coloring matter without the formation of oxycellulose The bleaching process can therefore be carried out without the otherwise necessary rigid control of time, temperature, and concentration, the goods can be bleached to a high brightness, and the resulting product is physically stronger than that bleached by hypochlorite

Kraft, or high-strength, paper can usually be only



Courtesy Bulkley, Dunton, and Company, Inc.

In such ceramic-lined tanks as this sodium chlorite bleaches paper pulp partially bleached, because of the fiber-weakening effect of the hypochlorite (hence the brown color of paper bags and wrapping paper) A high-strength white paper is possible, however, if sodium chlorite is used as the bleach The oxygen-chlorine content of the compound is sufficient to turn the brown, insoluble lignin into a colorless, soluble matter, but insufficient to injure the cellulose

This same property of selective oxidation possessed by sodium chlorite has made it possible to produce rag paper pulp for high grade paper from the lowest grade of cotton fiber Such fiber contains coloring matter that cannot be successfully destroyed with hypochlorite without injury to fiber-strength, so that unless sodium chlorite is used as a bleach, expensive cotton clippings and rags must go into the process of producing rag paper

PRODUCES CHLORINE DIOXIDE — Chlorine dioxide is a yellow to red, dense gas, with an irritating odor It decomposes with explosive violence Because it is so extremely reactive, it cannot be manufactured and shipped in bulk, but must be prepared where it is to be used, and then consumed immediately Early methods for chlorine dioxide's preparation were not commercially practical because the reactions were difficult to control and contaminating substances were formed

Sodium chlorite now provides a practical source of chlorine dioxide through reaction with chlorine When chlorine gas is passed through a solution of sodium chlorite or through a mass of sodium chlorite flakes, chlorine dioxide gas is given off And if the gas is carried off during the reaction, exceedingly high yields are obtained

The remarkable oxidizing power of chlorine dioxide makes it an excellent bleach for flour, fats and oils, and starch, it has many other potential uses that are still in the development stage, such as checking blue mold in citrus fruits, and aiding in the preservation of vegetables

For these uses, chlorine dioxide is generated by the dry process, that is, by a stream of chlorine gas passing through a mass of sodium chlorite flakes Two towers—the size depending on the quantity of the gas desired—lined with a stoneware or glass, are filled almost to the top with flaked sodium chlorite A stream of air and chlorine is fed into the bottom of the first tower, and chlorine dioxide is formed as the chlorine passes up to the top Complete reaction is assured by passing the gas mixture through the second tower The air serves not only to carry the chlorine, but also to dilute the chlorine dioxide below a critical concentration—a very important safety measure Various control and measuring devices make it possible to produce exactly the quantity of chlorine dioxide required, at the proper rate Ample safety devices are included to prevent the concentration of chlorine dioxide from exceeding a certain safe maximum

• LOOKING AHEAD •

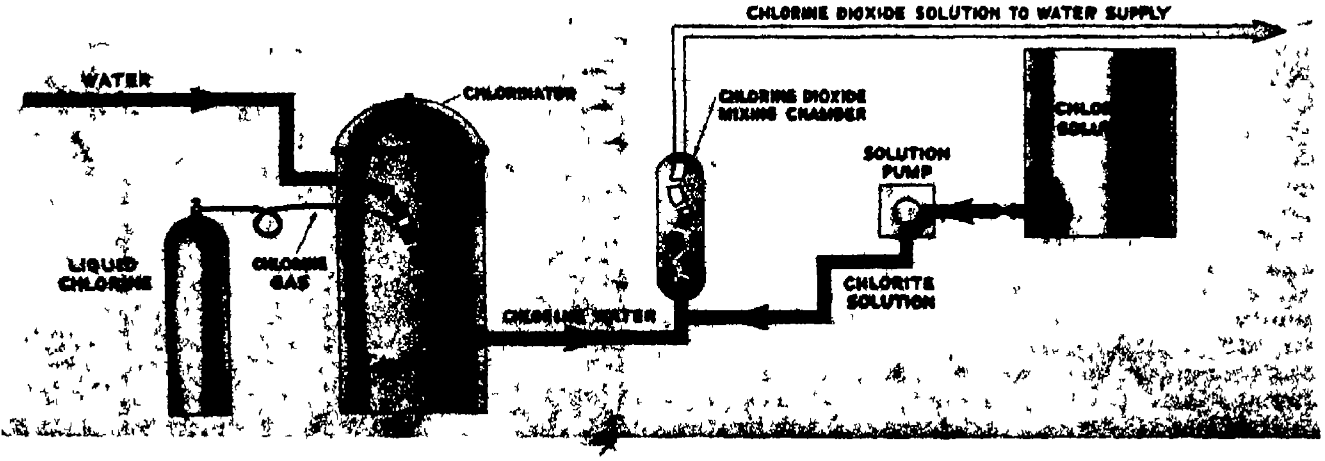
Paper and textiles bleached more effectively with no danger of loss of strength Low quality fats up-graded for successful use in high-quality soaps Fruit spoilage in storage reduced More efficient treatment of drinking water removing all unpleasant tastes and smells High-grade paper made from the lowest grade of cotton fibers

FLOUR BLEACH — For bleaching flour, chlorine dioxide is very efficient It takes about twice as much nitrogen trichloride, conventionally used for the purpose, to do an equivalent job Chlorine dioxide also exerts a maturing action on flours, producing a dry, easily-handled dough, and improving the grain and the loaf-volume of the bread. In the bleaching process, a stream of air and chlorine dioxide, coming from the generator towers, is passed through the flour to obtain the desired degree of bleaching

Until recently, there was some hesitation on the part of soap manufacturers to use chemical methods for fat bleaching It was feared that any chemical which would be effective as a bleach would also

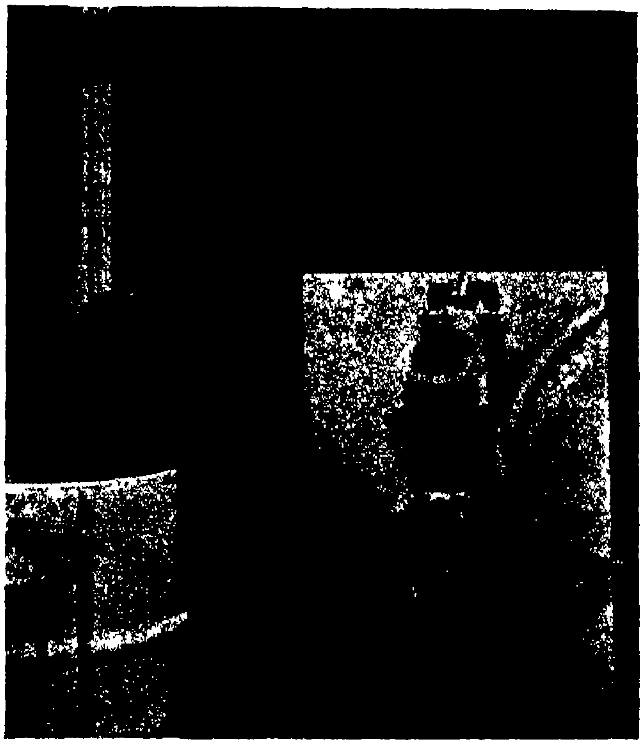
Flow diagram showing generation of chlorine dioxide solution using a chlorite solution and chlorine water

Courtesy Mathieson Alkali Works, Inc



cause deterioration of the fat Now it has been demonstrated that fat bleaching with chlorine dioxide affects only the color and odor of the material treated Crude fats, such as household waste fats, are thus up-graded to a quality that makes them suitable for the manufacture of high-grade laundry flakes and toilet soaps, and the color and odor of refined fats are considerably improved

As in the case of flour bleaching, the dry process of generating chlorine dioxide is used here The fats are refined in the usual manner, washed, and allowed to settle They are then heated to from 180 to 212 degrees, Fahrenheit, and a stream of chlorine dioxide gas and air is passed into the bottom of the kettle and up through the fats



Mixing chamber in a water treating system. Here a sodium chlorite solution is reacted with chlorine water to form chlorine dioxide

IN WATER TREATMENT — Much of the unpleasant flavor of water in many areas comes from vegetation, or algae picked up as the water passes through the countryside, especially through forests and swampy areas Also, factories dump industrial wastes into the water supply, causing similar disagreeable results Sometimes the water supply is subject to both types of contamination

In order to destroy bacteria and to make the water safe for drinking, it is usually treated with chlorine gas But although the chlorine makes the water safe, it does not always destroy its unpleasant qualities, as many long-suffering communities know only too well. And sometimes the chlorine combines with the impurities in the water to form compounds that have even stronger tastes and odors Chlorine dioxide solves this problem.

For water treatment, the wet process of generating chlorine dioxide is used A solution of sodium chlorite is passed into a mixing chamber, into which is passed also the chlorine solution produced by the plant's chlorinator The chlorine is thoroughly mixed with the chlorite solution to produce the chlorine dioxide solution that is then fed into the system The chlorine dioxide is usually added after the water has been disinfected with chlorine, settled, and filtered

Cities and towns in New York, Maine, South Carolina, Ohio, Pennsylvania, Michigan, Kansas, West Virginia, Iowa, Rhode Island, Tennessee, California, and Massachusetts, and communities in Canada that formerly suffered from unpleasant tasting water are now using the chlorine dioxide process The result is a water supply that is entirely satisfactory

Recent work by scientists at the University of Michigan's School of Public Health indicates that the bactericidal properties of chlorine dioxide are as great as or slightly greater than those of chlorine Of special interest was the fact that the bactericidal efficiency of chlorine dioxide is relatively unaffected by alkalinity such as that which occurs naturally in some waters, or in waters that have been treated to prevent corrosion, and also in waters that have been "softened" In such cases, the amount of chlorine needed for disinfection increases by two or three times If present findings are confirmed, chlorine dioxide may prove to be an even greater aid to good water treatment in many municipalities

Carbon dioxide, fed in at the bottom of this conical tank, bubbles up through the liquid fat, deodorizing and bleaching it

Courtesy Mathieson Alkali Works, Inc

THE FOUNDRY OF TOMORROW --Today

Through Application of Modern Machines and Methods to the Ancient Art of Casting, A Foundry's Atmosphere Can Be Cleared of Dust and Smoke, and Much Back-Breaking Work Eliminated Only Thus Can a Foundry Hope to Meet Successfully the Ever-Increasing Competition for High-Quality Labor, and the Rapidly Growing Need for More and Better Castings

By C. B. Dick
Manager, Feeder Division,
Westinghouse Electric Corporation

FOUNDRY work—the art of casting metal—is one of the oldest and most important of all basic industries. But for many years it was one of industry's toughest and dirtiest jobs Recently, however, this ancient art has collided violently with the age of push-button machinery and fluorescent lighting

This collision was brought about by a number of things—competition for high-caliber labor, greater demand for castings, and new emphasis on quality, to name a few

Whatever the reasons, the results have been fascinating to watch In spite of the fact that in all too many places, John Jones, foundryman, still wears the tell-tale marks of his trade—dirt and grime—in some foundries he now comes to work in clean clothes, and he looks and feels like a gentleman when he goes home The job at which he works all day is no longer the back-bending, muscle-mauler it once was John's morale is higher, his pay is higher, and his work is more efficient

One example of a foundry "gone modern" is that of the Westinghouse Feeder Division at Trafford, Pennsylvania, which has been dubbed "the foundry of tomorrow" However flattering this reference may be, the Trafford foundry is still enough different from that of yesterday to startle the veteran foundryman who may have lost touch with his trade for a few years.

As you might expect, the basic job is the same today as always. Furnaces must be fired, and metal melted Sand must be brought in to form molds and cores And the cooled metal casting must still be removed from the mold and cleaned.

Replacing the traditional hand shovel, this "sandslinger" hurls 1000 pounds of sand a minute into the mold

A backward look at an imaginary foundry of the old school will show how the job of casting metal was done

First, railroad cars dumped sand into cellar bins There began a sand-handling process with the emphasis on the word "hand"

The sand was hand-delivered to the mixing stations where it was mixed with such binding materials as cereal, oil, and water to make it stick together when pressed into form A workman shoveled the sand into the mixer, added oil and water or other binder-materials by hand-bucket, and once again the sand was moved by hand methods to the various core-making stations. There hand tools were depended upon to form the sand core

To form the mold into which molten metal was to be poured, the metal or wood pattern was set in place in a flask or box, and the sand was hand-shoveled in To pack it down, the workman used the handle end of the shovel, or other ramming implement

Molten metal was prepared in the big cupola, or furnace, which was fed by a charge containing coke, scrap iron, pig iron, limestone, and other ingredients These ingredients were shoveled into a dump container The container was then pushed to the cupola, and upturned

Once the metal had been cast in the mold, the problem remained to get the solidified casting out of its sand strait-jacket The old time foundry solved this one easily enough Men wielding large hammers simply knocked the casting loose from the flask

It should be remembered that the men doing these "easy" jobs were working in a smoke- and dust-filled atmosphere, probably in bad light And at the end of the day they trudged home to spend some of their leisure time scrubbing up

All foundries were not alike, of course Some were better than others But by and large, a foundry like the hypothetical one just described was quite typical

More recently, however, foundries were faced with great competition for labor Obviously, conditions had to be improved to attract workers Costs were soaring and the need was evident for improvements in production techniques and facilities

FOUNDRY MECHANIZED—Although the Trafford foundry was fairly well equipped, the opportunity was seized to push modernization further when, in 1940, plans were made to increase floor area by 30 percent to meet the great demand for castings So began a "face-lifting" program involving both mechanization and modernization for which the Trafford foundry still is serving as a working laboratory

Already the number of electric motors had been doubled, countless manual operations once requiring human strength and endurance are being done with the aid of newly devised machinery, fluorescent lighting and air conditioning have put in their appearance.

First section of the foundry to be tackled was the core room, where small- and medium-sized sand cores are prepared Here some 75 tons of silica sand are required daily

Today, a 50-ton, under-floor hopper catches carload lots of sand as it is dumped from the railroad car A power conveyor moves it to a large revolving drier that dries six tons of sand an hour (in other days, foundries did not dry the sand at all) The purpose of sand drying is to control accurately the core sand mixtures from standpoint of moisture-content, a factor which is critical in the production of high quality castings.

An elevator and distributing belt deliver this sand to large overhead storage bins The workman standing beside the rotating mixer merely opens an overhead shute to drop the correct amount of sand into the mixer. Handy discharge outlets at the mixer enable him to add core oil and water by simply turning valves instead of lifting buckets Meters indicate the exact amounts added. Not only is the job now easier, it is far more accurate

All pictures courtesy Westinghouse Electric Corporation

Core sand is now processed under the cool brilliance of many fluorescent lamps

Processed core sand is distributed to the ground floor by electric trucks, and by an electric hoist to a second-floor sand-distributing station directly above the core-making positions From this station one operator, with the aid of a two-wheel dump buggy, can furnish core sand to overhead bins serving the 40 work positions below

In forming the larger cores, "roll-over" machines turn the heavy forms, instead of human muscle doing the job Both gravity- and power-driven conveyors move the cores to the vertical-type baking ovens, where they are lowered to the first floor while the baking progresses—one more way to avoid lost time To form molds into which the molten metal will be poured, the mechanized sand-handling system once again comes into play, and a machine called the "sandslinger" takes the spotlight Here, instead of the workman shoveling sand and tamping it down with the shovel handle, the sandslinger does the job faster, better, and more easily

RIDES MACHINE — Guided by the operator—who in some cases even rides the machine like the Hollywood camerman on his movable boom—the sandslinger receives sand on a belt from the overhead bin and hurls it into the mold flask at the rate of 1000 pounds a minute The centrifugal force of a 40-horsepower motor packs the sand evenly and quickly

The metal is rapidly prepared for casting by a two-man crew with the aid of an overhead yard crane equipped with a magnet for lifting metal The two men stand beside the large charging bucket which moves along a track on a transfer car, collecting its load. Then a moving crane operated by one man carries the bucket to the cupola and dumps it

Small "holding furnaces" located near the molding sections provide another means of avoiding unproductive "waits" in the process Their reservoir of available metal assures a constant supply Ladles of molten metal are delivered to the pouring stations by electric platform trucks and overhead cranes

When the metal has been poured and has solidified, automatic shake-out machines quickly clear the casting from the flask, without workmen swinging heavy hammers The castings then are delivered by conveyor to the cleaning floor

As for the cleaning and chipping floor, it suffices to say that Trafford has a full complement of automatic equipment

The introduction of mechanized processes and intricate machinery into the foundry requires high-caliber, technically trained men. And to attract them, tomorrow's foundry has to be clean, comfortable, and safe Not that any foundry will rival a hospital for spic and span appearance, but the old time dirt and filth cannot be tolerated And it need not be

Air-conditioned locker rooms for the foundry workers are not equalled by those of many of the best country clubs All lockers are continuously ventilated by a stream of air exhausted downward through holes in the locker floor This keeps work clothes dry and fresh Light and roomy showers and great circular washbowls provide adequate washing facilities for all Most of the men shower and dress at the foundry and are given time to do so before the end of the shift, so that they can leave the foundry at the end of the day as clean as they were when they entered

Dust and smoke, characteristic of the old time foundry, have been suppressed by providing hoods, ducts, exhaust blowers, and filtering equipment, as well as by concentrating the points at which dust and fumes are created This feature, plus the elimination of heavy-lifting jobs, has resulted in a general improvement in the health of the workers

Complete safety equipment—goggles (which are sterilized regularly), heavy gloves, knee pads, shin guards—is provided without charge for each workman in accordance with the requirements of his particular job The employe must purchase only safety shoes

Although complete safety precautions are taken, a well-equipped first aid station is maintained at the foundry, staffed by a regular doctor, and with a registered nurse in attendance at all times Here complete X-ray and other medical laboratory facilities are available Periodic chest X-rays are required for everyone, and studies are made of foundry conditions from the standpoint of health

RESULTS — In adding up results, it is difficult to produce figures in balance-sheet form Certain facts have been proved, however As the result of our foundry program, production is up, absenteeism is down Workers health is improved, and most important, high-quality personnel is attracted to the jobs

Even the quality of our output has benefited from the application of 1947 methods to a job far older than the machine age Metal castings are now produced of greater dimensional accuracy than hand operations ever would permit.

• LOOKING AHEAD •

Basis established for similar improvements throughout the entire industry . . . Better castings of higher dimensional accuracy . . . Worker-morale vastly improved . . . Foundry jobs gaining reputation of good jobs

The Trafford foundry, while advanced in many ways, is still only a starting point for what, it is hoped, will be achieved eventually both in this foundry, and in many others

It has been said that most of the 5000 foundries in the United States are operating at, or near, capacity right now If this is true, the nation's foundries cannot produce sufficient castings to meet the tremendous, ever-increasing demand

The efficiency and productivity of foundry operations depend upon the caliber of managers, supervisors, and workmen doing the job We must face the fact that the old, out-moded foundry will not attract the men we want A modernized, mechanized foundry will

Whether America's foundries become a bottleneck or a booster station in the flow of full production depends upon the industry's leadership and its acceptance of modernization and mechanization for the purpose of making the foundry a good place to work, of creating the foundry of tomorrow—today

Excellent washing facilities enable the men to leave the foundry as clean as they were when they entered

HARD FACES Live Long

By *H. R. Clauser*
Associate Editor, MATERIALS & METHODS

Applying a Coat of Hard, Wear-Resistant Alloy to a Base of Less Durable Metal Results in Parts That Give High-Alloy Performance Without High-Alloy Costs

GENERALLY speaking, it is the rate at which the surfaces of a part wear, which determines that part's life expectancy. And in order to reduce that wear, to increase that life expectancy, industry more and more frequently has employed a process by which a layer of hard, wear-resistant alloy to spread on top of the softer, less expensive surface that would normally wear rapidly. By this technique, known as hard-facing, it is possible to achieve high-alloy performance without the usual high-alloy expense.

Hard-facing is by no means new. But it was not until a relatively few years ago that the technique came into common practice. In recent years, and particularly during the war, the conservation of many metals became a matter of prime importance. Industry seized upon hard-facing, not only as a means of increasing the service-lives of countless types of tools and parts, but also as a method of reducing the amounts of critically short high-alloys needed in parts demanding the utmost wear-resistance.

Hard-facing can extend the lives of such assemblies as valves, bearings, bushings, sleeves, shovel teeth, and machine tools as much as 25 times. And in addition to promoting conservation of the high-alloys, the process often enables far more economical designs by permitting cheaper base metals in parts to be subjected to heavy wear.

Hard-facing was originally applied on oil well drilling tools and excavating equipment. Its success there prompted its use elsewhere, so that now hard-facing has found applications in almost every field of industrial activity.

HARD-FACING MATERIALS — **There are virtually hundreds of different hard-facing alloys on the market today, and new ones are being introduced continually. However, practically all hard-facing materials can be sifted down into a few major classifications**, the alloys falling into each of **these** classifications having many of the same **general** properties and characteristics.

The first of these groups, and perhaps the largest, is composed of the iron-base materials. The alloys in this group that contain only small amounts of alloying elements (up to 20 percent), are lowest in cost, and are primarily for application by arc welding on large parts, and as a base for other more expensive hard-facing alloys. Their principle characteristics are relatively high hardness along with satisfactory toughness to withstand impact. The chief alloying elements are chromium, manganese, and silicon.

What might be considered a subdivision of this group, is another iron-base group made up of materials having alloy contents ranging above 20 percent. These are, of course, higher priced than the lower alloy materials, but they are usually harder and more resistant to abrasive wear. The chief alloying element is chromium.

Some of these iron base materials are often referred to as "self-hardening," because they are relatively soft when first deposited, but when subjected to impact in service, the surface becomes harder. Below the hardened surface, however, the deposit remains comparatively soft, and so gives good impact-resistance.

Another classification of hard-facing materials consists of non-ferrous alloys that are made up chiefly of cobalt, chromium, and tungsten. These alloys have the quality known as "red hardness," that is, when heated to high temperatures, they retain most of the hardness they have at room temperature. This property makes these alloys particularly valuable for high-temperature wear-resistant applications. They also have the ability to resist many corrosive agents and oxidation at elevated temperatures.

Those materials comprising a third group are often referred to as diamond substitutes. Their hardness approaching that of a diamond, these materials usually consist of tungsten carbides, and come in the form of rods, as powder, or as solid inserts. The materials of this group are the most expensive. They offer the maximum in wear-resistance at both normal and high temperatures, but have low impact-strength as compared with the alloys in the other groups.

APPLIED BY WELDING — The most widely used method of applying hard-facing alloys is welding, and arc welding is generally most economical. It is rapid and can be used to advantage where thick layers are required. It provides the most intense source of heat and rapidly melts the hard-facing rod, fusing it to the base material.

Oxyacetylene welding is a very flexible method. It creates a less intense heat than arc welding, and good bonding of the hard-facing alloy is obtained with a minimum of weld penetration into the base material. It also gives a smooth weld deposit.

Besides gas and electric arc welding, atomic hydrogen and inert-gas-shielded arc welding methods are occasionally used for hard-facing

In recent years, in order to speed up hard-facing operations, the welding process has been mechanized, with oxyacetylene methods generally most adaptable to mechanization In addition to the very obvious advantage of a greatly increased output, mechanized processing also tends to reduce costs, since fewer and less skilled operators are required In addition, the work is more uniform and there are fewer rejects Flat, regular pieces and cylindrical objects are best suited to mechanized hard-facing

The several types of surfacing operations that have been developed include straight-line, cylindrical, and spiral types In a straight-line operation, for example, a multiple-flame head is fixed with flames directed to bring the base metal to sweating temperature, melt the hard-facing rod, and distribute the molten metal to the desired points The head is mounted on a motorized carriage, and the rod feed is mechanical.

For parts such as pump rods, bushings, and rolls of all kinds, the cylindrical and spiral methods are used In the cylindrical method, the entire length of the part is surfaced in one revolution of the work by rotating it slowly while the weld metal is deposited Multiple welding rods pass through tubes and between converging flames that melt the rods just above the work

The spiral method is basically like the straight-line method A narrow ribbon of hard-facing alloy is deposited in a continuous spiral as the welding head moves along the rotating work-piece Each successive spiral overlaps the previous one to form a continuous surface layer

Where parts are not adaptable to mechanized hard-facing, as in the case of such parts as gears, drill bits, sprocket teeth, and earth scraper blades, semi-automatic methods have been developed In one new

• LOOKING AHEAD •

Hard-facing gaining ever-increasing acceptance . Service life of metal parts of many sorts greatly lengthened . Manufacturing costs cut where quantity of higher alloys is reduced Sharp drop in down-time for repair or replacement of worn parts

Rebuilding a large, badly worn hydraulic plunger by the submerged arc welding method

Courtesy Linde Air Products Company

process, crushed tungsten carbide alloys can be welded superficially on a surface by using a powder dispenser and an oxyacetylene torch. The area to be hard-faced is brought to a sweating temperature, and then tungsten carbide granules are poured from a dispenser onto the sweating surface In a few seconds, the desired depth of facing material is built up and the flow of granules is stopped

SUBMERGED MELT WELDING — In recent years submerged melt welding, or hidden arc welding, as it is sometimes called, has aroused considerable interest as a fast and automatic means of hard-facing In this method, both the arc and the welding rod are completely submerged in a granular flux during welding Most of the work done by the process has centered about rebuilding worn parts with weld metal of similar composition or of similar wear resistance More recently, however, surfacing with dissimilar materials has been done For example, cast steel valves have been faced with stainless materials which gave far better wear- and corrosion-resistance than normally is obtained from cast steel

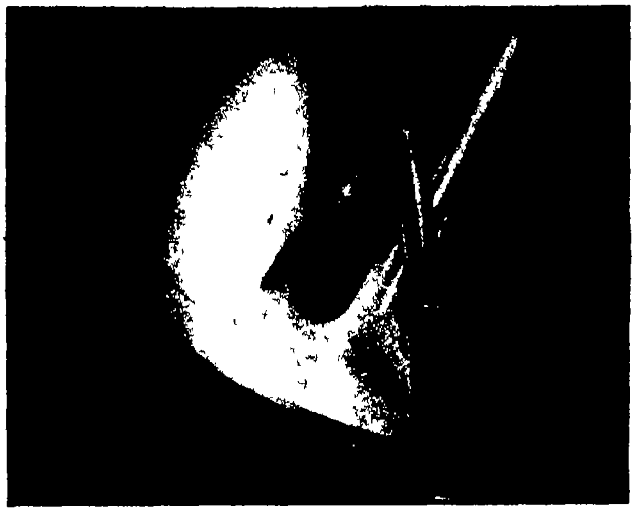
Submerged melt welding has the advantages of a high speed of rod deposition, minimum rod loss, and minimum subsequent machining Development work on this type of welding for hard-facing is continuing and will probably see a large increase in its use

Two new and rather unusual methods of applying hard-facing materials in powder form have been developed, and are now in service Known as the "Powder-Weld" and the "Spray-Weld" processes, the methods involve spraying a surface with hard-facing alloy, using a regular metallizing gun or a special powder torch, and then fusing this powder overlay with either an oxyaceytlene flame, induction heating equipment, or a controlled-atmosphere furnace The result is a fusion bond between the powder overlay and the base material similar to that obtained when gas welding is used to deposit the hard-facing rod Both processes consist of three steps, and the difference between them lies in the second step

The first step of both methods is to prepare the surface following, in general, regular metallizing practice The surface should be grit blasted, especially if it is softer than 28 Rockwell C This blasting improves the mechanical bond holding the sprayed powder until the fusion bond is accomplished

Next, the powdered hard-facing alloy is sprayed onto the prepared surface It is here that the two processes differ With the Power-Weld process, the powder is sprayed through a newly developed metallizing system. The equipment consists of a torch, control box with pressure regulating valves, and a canister holding the powder The torch is similar to an ordinary gas welding torch The process normally uses three gases oxygen, a fuel gas as acetylene or a natural or manufactured gas, and an inert gas such as nitrogen or argon to provide a protecting atmosphere around the powder as it is sprayed A mixture of flux and the powdered alloy is shot through the flame and onto the work.

PLASTICS-METAL ROD — With the Spray-Weld process, the powdered metal is pressed together with a plastics binder in the form of a rod which is fed through a regular wire metallizing gun When the rod passes through the flame, the plastic burns, producing a reducing atmosphere to protect the meta' particles from oxidation as they are deposited



Hard-facing with an oxyacetylene torch gives a good bond with a minimum of weld penetration

After spraying, the final step, the same with either process, is to fuse the overlay to the base metal The Powder-Weld torch or an ordinary gas welding torch is most practical where only a few small pieces are being processed With greater quantities, or with large flat pieces, it is usually more efficient to use a controlled-atmosphere furnace And if the objects are cylindrical, induction heating should be considered

Whatever method is used, the temperature required for bonding ranges from 1850 to 2050 degrees, Fahrenheit The resulting faced part will have a smooth surface and a hardness of 55 to 60 Rockwell C

At present, these two processes are limited to one hard-facing material, a nickel-chromium-boron alloy It can be used to hard-face steel, stainless steels, cast and Meehanite irons, and copper and some of its alloys. It gives a porosity-free overlay with high wear- and corrosion-resistance The minimum thickness of overlay is 0 010 inch The Maximum thickness that can be applied with the Powder-Weld process is 0 050 inch and a 0 060 inch maximum with the Spray-Weld process Any contour may be followed, so the processes are applicable to any pieces whose surfaces can be sprayed, and where any one of the heating mediums for bonding can be used without harm to the part.

A number of other powdered metals and fluxes are under development, and as they become available the range of hard-facing applications by these processes will certainly expand

By greatly extending the service lives of countless metal parts, hard-facing reduces the number of otherwise frequent and expensive replacements. It permits the use of a smaller amount of costly high-alloys in the manufacture of many parts designed for heavy wear And it facilitates production by cutting sharply the hours lost as down-time while parts are being repaired or replaced

Thus hard-facing, which served so well during the war, promoting conservation of scarce alloys, again serves well in days when costs are critical, and high production is essential.

The free-flowing casting resin is poured into a suitable mold containing the circuit components. When solidified, the resin assures unusually good electrical and mechanical stability

Electronic Preserves

By
P. J. Franklin
and
M. Weinberg
National Bureau of Standards

By Embedding Entire Electronic Circuits In a New Casting Resin, They Can Be Given Unusually Great Mechanical Stability, And at the Same Time Proofed Against Moisture and Corrosive Fumes of Many Types

ELECTRICAL and mechanical stability of a delicate electronic circuit is seldom easy to achieve But when that circuit is to be subjected to the most violent shock and vibration, to heavy moisture, and to corrosive atmospheres of all sorts, the problem of stabilization assumes Gargantuan dimensions

Many miniature war-developed circuits—such as those of the proximity fuse—had to function under just these conditions And it was in search of an answer to the problem of securing the required stabilization for these circuits that the National Bureau of Standards turned to a technique of embedding or "potting" entire electronic circuits in plastics, and developed a new resin for that purpose.

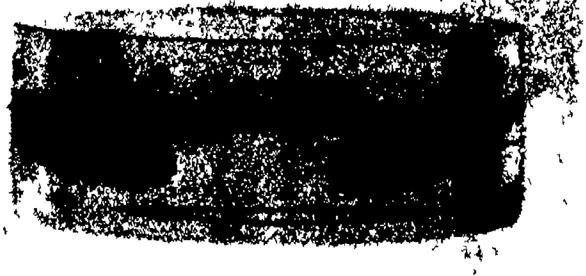
Called the NBS Casting Resin, this new material was developed as a result of extensive experimentation after it was learned that no resin then existing could fill the exacting electrical and mechanical requirements.

Due to the high impedance of the circuits involved, the electrical loss factor—the dissipation of the available energy in the potting compound—became a matter of major importance While many of the conventional resins supplied the required mechanical stability, and proofed the circuit against moisture and fumes, they were found electrically unsatisfactory And those few materials with adequate electrical properties were found deficient mechanically In addition, the applications required a resin of such viscosity that it would quickly encompass all the circuit elements when poured into the container housing the electronic device And the resin had to harden to a rigid solid without adversely affecting circuit-operation (many resins shrink on gelling, the shrinkage subjecting the electronic components, in some cases, to forces amounting to several tons per square inch)

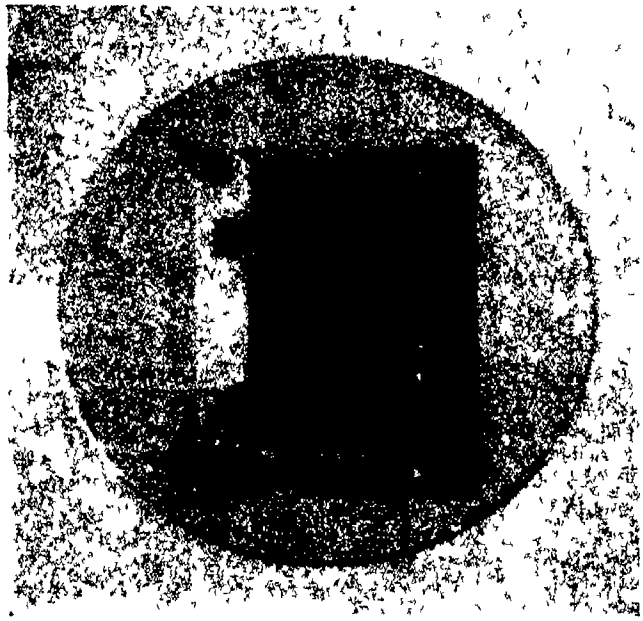
The new resin, which was developed as a result of experience gained in the proximity fuse program, meets all the requirements of a compound for potting high-frequency circuits low power loss, good insulating properties, high impact strength, dimensional and electrical stability, low moisture absorption, and

• LOOKING AHEAD •

Complete "plug-in" stages Electronic circuits operation, virtually unaffected by shock, vibration, or contaminated atmospheres Extension of applications of electronic controlling and safety devices as a result



Side view (above) and top view (below) of a potted double-stage amplifier unit



low volumetric shrinkage during the period of polymerization In addition to this, the new resin is easily poured through small openings because of its low viscosity and low surface tension

HOW RESIN IS PREPARED — Preparation of the casting resin is relatively simple Immediately after putting the components in a suitable mixing vessel, the mixture is placed on a roll mill to prevent clumping, and is rolled until it is viscous

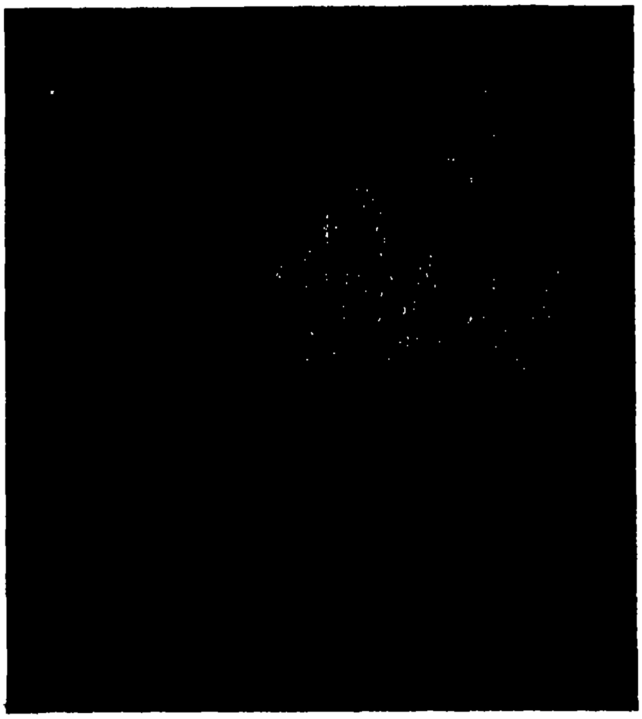
After about 16 hours of continuous rolling, the casting resin is ready for use, requiring only the proper quantity of catalyst to initiate polymerization

Electrical properties of the resin are affected only to a minor extent by the method of polymerization The length of time for polymerization of the resin, therefore, should be the minimum required to build up to a point beyond which there is no improvement in mechanical qualities of the plastics The minimum time, however, varies with the catalyst, the percentage of catalyst used, and the temperatures at which polymerization is initiated and carried out In addition, the size of the casting must be considered

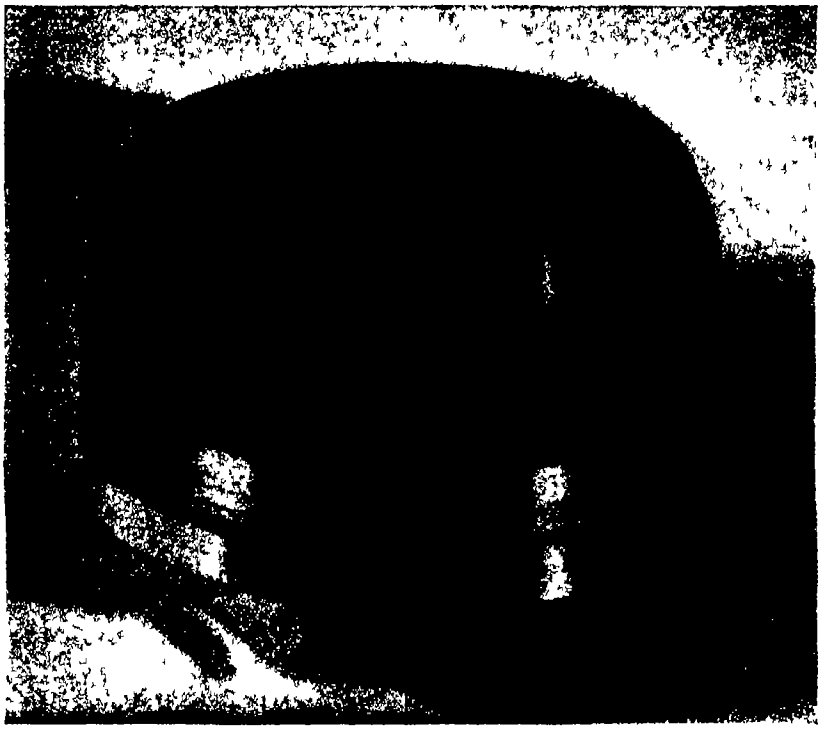
When employing the NBS Casting Resin in devices using glass vacuum tubes, proper protection for the tubes, such as rubber jackets, should be provided to prevent possible cracking from thermal and mechanical shock All sharp corners should be eliminated from any object to be embedded, because strains set up at these points might cause crazing or cracking of the plastics In order to eliminate, or reduce, strains, and to obtain maximum hardness and total polymerization, the plastics is cured in an oven for several days after casting

When objects are to be suspended within the center of the casting resin, it is advisable first to gel a portion of the casting resin, and then allow the gelled resin to support the object The mold is next filled completely with the casting resin and cured, after which the line of demarkation is invisible Glass and properly lubricated metal molds have been used successfully, and silicone grease is suggested as a lubricant.

EXTENDS ELECTRONIC APPLICATIONS — Various applications at the National Bureau of Standards indicate that, with slight modifications to suit the intended use, the resin can be readily employed in many high-frequency devices requiring such electrical-mechanical insulation And the special features



Eight ingredients of the resin are placed in wide mouth jars and then rolled on a rolling mill for about 16 hours



All pictures courtesy National Bureau of Standards

This plug-in multi-stage electronic control unit, potted in the new casting resin, will operate efficiently and reliably under the most severe conditions

of the NBS resin make feasible many new applications of electronic devices where severe operating conditions have heretofore barred them The resin should be especially useful in high-impedance control and safety devices in heavy industry, where it would provide adequate protection for circuits against heavy vibration, salt spray, acid fumes, or high-humidity

Potting circuits can mean even more reliable service from such devices as hearing aids, portable radio transmitters and receivers, radar equipment (especially the smaller air-borne units), and numerous subminiature electronic control devices

The resin is particularly well adapted for use with the subminiature electronic circuits built by the National Bureau of Standard's circuit-printing technique (see Mass-Production Wiring, page 116, Scientific American, September, 1947) And complete potted plug-in stages for electronic equipment of all types, even standard broadcast receivers, would simplify servicing to a point where it would be little more complicated than changing a light bulb

The potentialities of the potting process are certainly great. And while many possibilities have yet to appear on the horizon, it is safe to assume that there are few phases of electronics, either industrial or commercial, to which the process could not bring more efficient, more dependable service

Formula For Casting Resin

COMPOUNDS	AMOUNT BY WEIGHT—%
2,5-dichlorostyrene	33.0
Poly 2,5 dichlorostyrene	21.5
Styrene monomer	21.0
Polystyrene	11.0
Hydrogenated terphenyl (Monsanto HB-40)	13.0
Solution containing 60% divinylbenzene (Dow Q302.4)	0.5

After the components are rolled, as described in the text, a catalyst such as 0.1% benzoyl peroxide is added to initiate polymerization. The National Bureau of Standards warns that, in the preparation of this formula, special treatment must be given the 2,5-dichlorostyrene and styrene, which may contain excessive amounts of inhibitors

Mechanical and Electrical Properties of Casting Resin

Compressive strength, lb/sq in	17,100
Coefficient of thermal expansion per °C	11 x 10^{-5} (approx.)
Water absorption (24 hours immersion) %	0.01
Volumetric shrinkage on polymerization %	8.0
Power factor (at 100 megacycles and 50% RH)	0.0004 - 0.0008
Dielectric constant (at 100 megacycles and 50% RH)	2.5
Dielectric strength (1/16 in sample, volts/mil)	610 - 660

Some of the measured properties of casting resin, cured at 50 degrees, Centigrade, employing benzoyl peroxide as the catalyst

Industry Looks to The Screen

The Unparalleled Teaching Abilities of The Sound Motion Picture Have Established for This Medium a Place of Ever-Increasing Importance on Many of Industry's Most Vital Training Programs

By O. H. Coelln
Editor, BUSINESS SCREEN

THE SOUND motion picture, as a means of putting ideas into men's heads, is in a class by itself. No other medium can claim to hold its audience in such rapt attention for so long a period of time, nor present its subject matter with such dramatic impact. And no other medium can hope to develop so close a relationship between the observer and the demonstration. The motion picture's unique ability to reveal graphically many phenomena invisible to human eyes, eliminates hours of involved description and explanation. And other motion-picture techniques such as the animated cartoon reduce many obscure points to readily understood terms in a remarkably short time.

Throughout all industry, the swing is toward training programs in which the conventional lectures, charts, manuals, and so on, are closely integrated with a series of carefully planned training films. So successful have these films been, that they are rapidly building for themselves an importance in industrial education comparable to the importance of the film in the entertainment world.

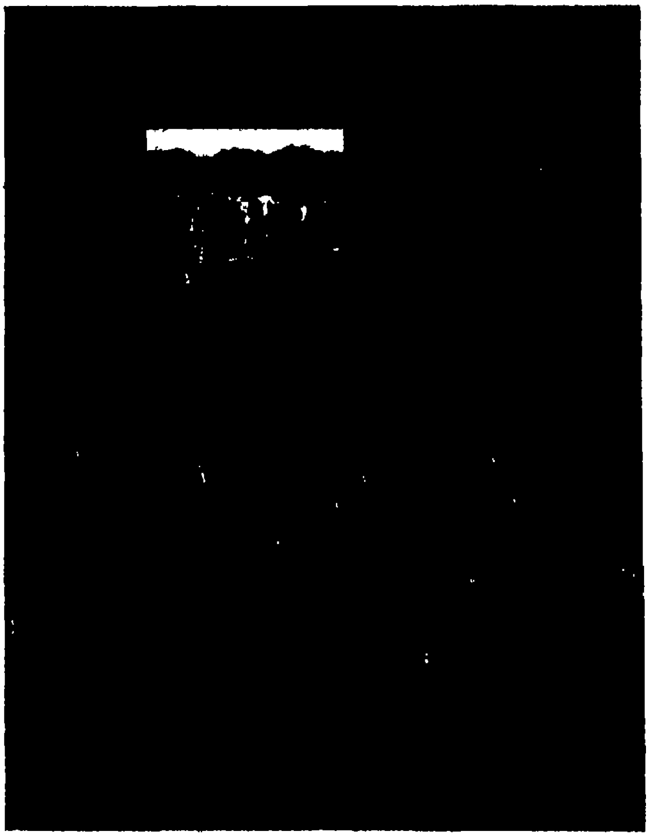
While the industrial training film had gotten off to a good start before World War II, the war gave it a tremendous boost. All branches of service and several of the civilian agencies made extensive use of sound motion pictures to teach specialized knowledge and skills, and to instill attitudes—both of which were extremely important to the successful prosecution of the war.

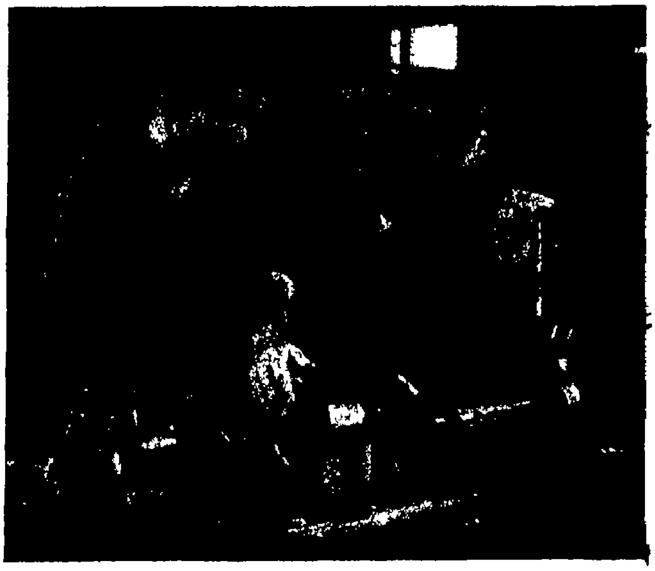
In three years, the Navy alone turned out 1100 training films averaging two reels each, and during the same period of time, produced 2200 slide-films. Motion pictures were used by the Army to teach the recruit how to kill or be killed, and to help him understand the meaning of the war in which he found himself. The United States Office of Education produced a total of 457 sound films. Each of these dealt with a training subject, and about 90 percent of them were "how-to-do-it" films covering all manner of subjects, ranging from how to install a propeller shaft, to how to shear a sheep. Films told war workers and their families how to can vegetables, cut meat, care for the new-born infant, and how to use magnesium welding flux.

EARLY FILMS DEFICIENT — In the earlier days of the training film, a company's entire motion picture training program all too often consisted of a *single* movie of a dull, pompous talk by a finger-waggling sales manager, or a flimsy, threadbare production which possessed all the reality of a high school melodrama.

Consider the difference between such a program, and the present application of visualized training and selling by one national company. In this year the Goodyear Tire and Rubber Company is shooting a total of 173,438 feet of film to make 10 sound pictures and 10 slide-films to be used in conjunction with a number of charts, a series of review quizzes,

The motion picture captures and holds the audience's attention as no other medium can

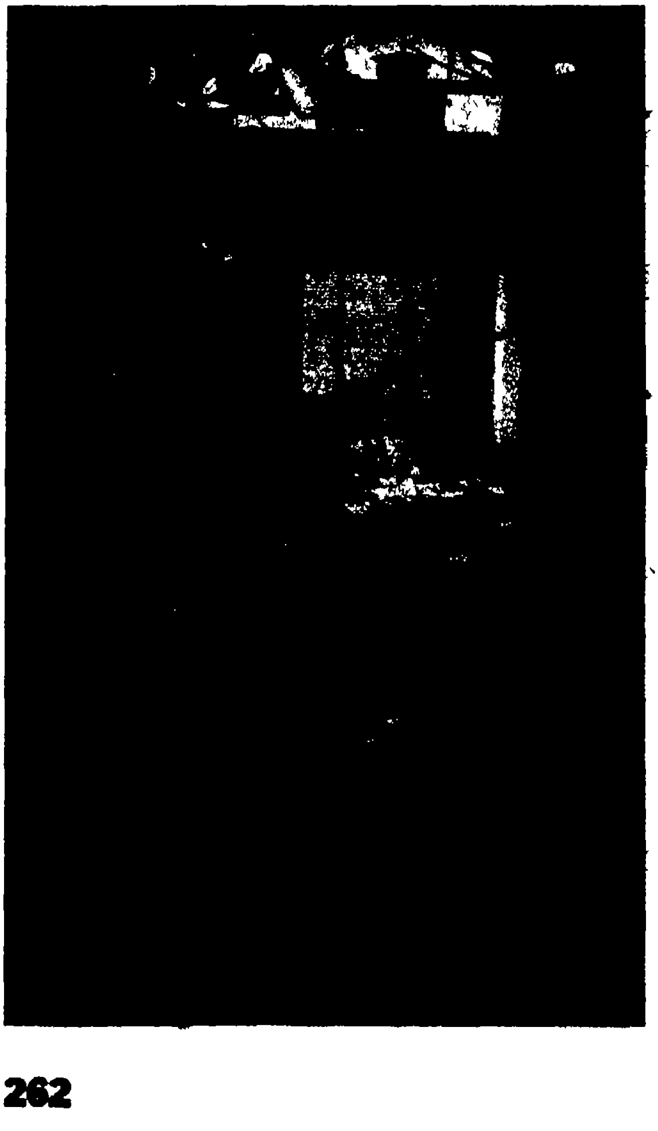




In motion pictures, such as this training film for handicapped workers, an unusually close relationship is possible between the trainee and the demonstration on the screen

A considerable amount of complicated equipment is needed to make the modern business picture

Courtesy Sarra, Inc



and a considerable amount of well integrated printed literature for a single program consisting of a two and one-half day school clinic for its dealers. Truck-borne projection units will carry all this material to 18,000 Goodyear dealers and their salesmen during the coming months

SOUND FILM IS CATALYST — If all of this has the aspect of synthetic, projector-fed learning, appearances are deceiving What has happened is simply this Industry's training methods have undergone a radical change Not that there has been a decrease in the time-honored tradition of face-to-face instruction But more and more frequently, the sound motion picture is being used along with all of the conventional teaching methods to "'catalyze" the training program

Careful study of the role of the motion picture in an educational program has established these facts

(1) The interest of the trainees in the subject matter is increased sometimes as much as 40 percent.

(2) Understanding of the subject matter is increased by an average of 25 percent.

(3) Retention of the subject matter is from 35 to 55 percent greater

Standard Oil of Indiana, United Air Lines, Socony-Vacuum, Sinclair, and others in the vanguard of American industry are far advanced in building the sales and training manuals, illustrated charts, and motion pictures into a single, closely knit program presented by well trained instructors

TYPICAL TRAINING PROGRAM — Training in many companies begins with historical background films to explain company traditions to new employees It continues through rather general material on good work habits, company and shop rules, safety education, and similar guidance The films get more specific in the teaching of skills Not that you can actually learn to operate a machine tool by watching a motion picture But controlled experiments show conclusively that trainees who see skill-type films have more confidence in approaching operating stations, and that they are better prepared for personal instruction Naturally, this results in lower material-loss through spoilage, less time required for learning the machine operation, and fewer fingers poked into fly-wheels

FILMED IN THE FIRST PERSON — An important feature of the motion picture as a training aid is the fact that the trainee subconsciously sees the hands on the screen as his own All films, in terms of camera work, are in the first person As a rule, in an actual shop demonstration, 90 percent of the trainees stand opposite the machine from the instructor, and so they must reverse everything they see him do By filming the scene from the instructor's side of the machine, however, the motion picture completely overcomes this handicap

But the abilities of the motion picture are by no means limited to the teaching of manual skills. Says John Shaw, Assistant Vice President of the American Telephone and Telegraph Company

"We use . films for motivation. We want to create in employees in all departments, the desire to do their jobs better The motion picture can pack more emotion into a minute than any other medium I know of, or have used We use them to carry in-

• LOOKING AHEAD •

More and better industrial training films Color rapidly gaining ground Time and materials saved through faster, more effective training Improvements in projection equipment leading toward lighter, simpler projectors

formation to carry facts to people, to carry basic ideas

"There is a tremendous barrier existing between the people in whose minds ideas originate and the people to whom the ideas should be communicated Anything that breaks down that barrier is worth while"

MAKES THE INVISIBLE VISIBLE— The motion picture extends the limits of the trainee's vision as no other medium can It permits him to observe closely phenomena which are too small, too fast, or too slow to be seen by the unaided eye Cinema photomicrography, the high-speed motion picture camera, which exposes 3000 frames a minute to capture the flight of objects moving far too swiftly for human sight, and micro-motion pictures, which cram the action of weeks or months (the growth of a plant, for example) into minutes on the screen, are among the techniques that make the invisible visible

An excellent example of how effectively the motion picture can reveal hidden facts is found in a film on the hatching of chickens by mass-production methods Produced for an audience consisting largely of poultry farmers, the film contained many of the usual scenes delivery of the fertile eggs to the hatching plant, preparing the eggs for the incubators, candling of eggs, sorting and sexing, packing, and so on What "made" the film, however, was the "inside story" of what happens in the egg during the 21 days of incubation. Micro-motion pictures followed the development of the embryo from the first signs of life, to the emergence of the chick on the 21st day—with every stage of formation and activity clearly visible Obviously, no other medium could have presented such a sequence

THEY LEARN WHILE THEY LAUGH — The animated cartoon has an almost uncanny ability to reduce and clarify many extremely difficult points to a level where they may be easily grasped Moving charts and diagrams, and cartooned analogies bring abstract and complicated principles down to simple terms And by treating a serious and important subject in a light and whimsical fashion, the animated cartoon can often achieve results little short of miraculous. The Army's "Private Snafu" series of training cartoons serves as a classic example The ridiculous antics of this supposedly mythical character, as he blundered through misfortune after misfortune, brought home vital facts with an effectiveness that hours of lecturing could not equal. Men roared with laughter But while they laughed, they learned such important lessons as malaria con-

Courtesy Shell Oil Company

Puppets filmed against a table-top set cleverly and forcefully tell an important sales story

Acres are compressed into a few square feet in this miniature oil-field set

Courtesy Raphael G Wolff Studios

trol, care of the M-1 rifle, and what to do during an air raid. Industry is now using this same principle to advantage. Animated cartoons, or cartoon sequences in regular motion pictures are achieving great success in lightening the often-heavy industrial education problems.

NO CAMERA NEEDED — Today, a company does not need to have a camera, nor must it hire a studio and photographer, to have an effective motion picture training program Films, ready-made and waiting, covering literally thousands of training subjects, can be borrowed or rented for a nominal charge Many of the major companies throughout all branches of industry have films which are available free, except for payment of shipping fees, and the United States Office of Education has a vast number of subjects which are available through regular commercial distributors

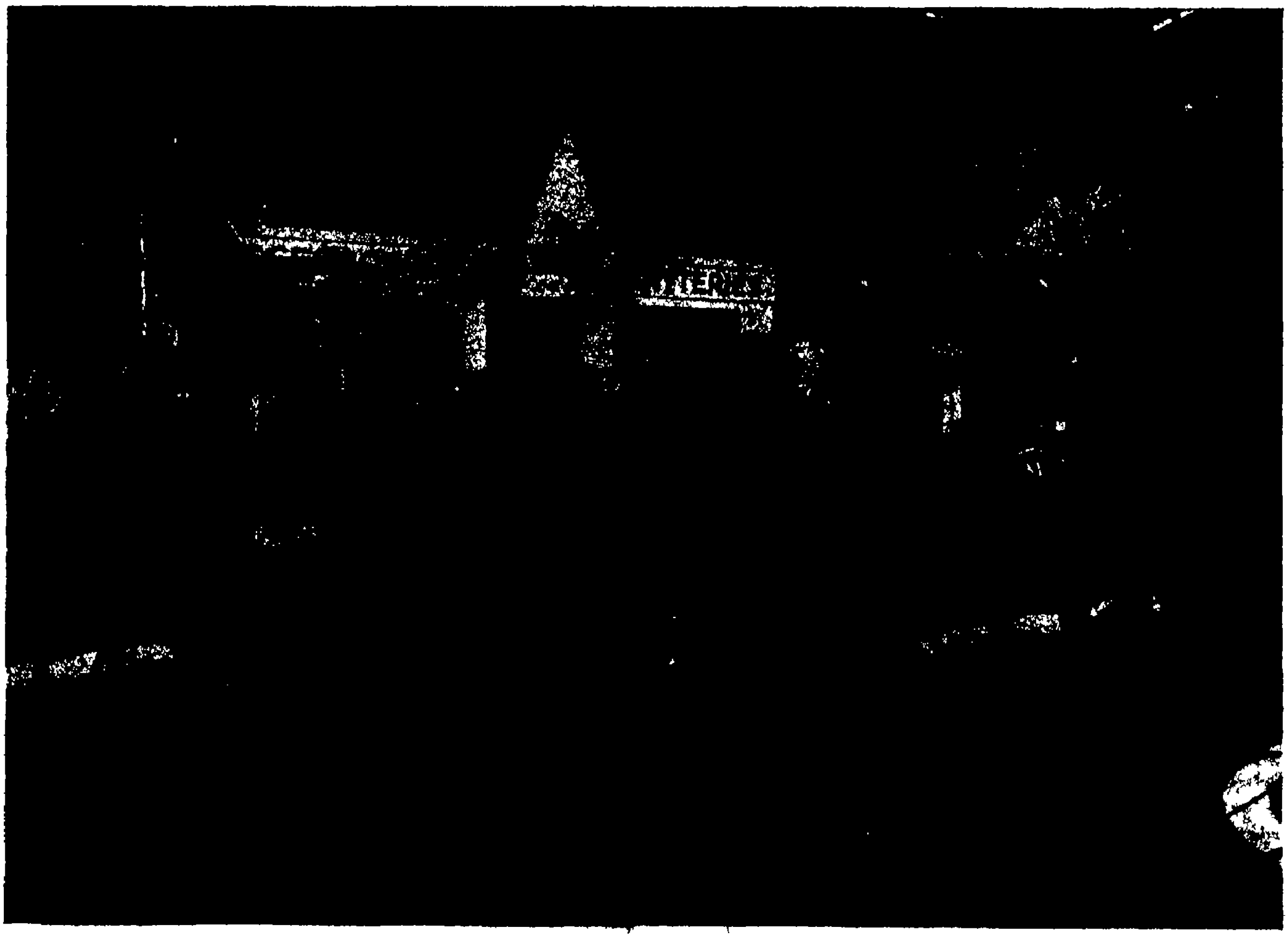
Projection equipment, improved by war-time standards, is more widely available now than at any time in the past five years The trend is toward lighter, simpler, less expensive projectors, with single case units replacing the larger two-case models. Magnesium, aluminum, and plastics, so evident in post-war projectors means greater portability

Courtesy Lincoln Electric Company

Whimsical animated cartoons of a serious subject can often lighten an otherwise difficult training task

The sound motion picture for business and industry, as for formal education, is an unfinished chapter in a half-written book Technogolical advance in motion picture technique is being made, slowly, but more surely Greater imagination and originality in picture making will once again be foremost to improve even more the sound motion picture—the greatest medium for putting ideas into men's heads that has even come to education.

Films teaching dealers and salesmen how to "sell" are among the most successful types of training pictures



SCIENTIFIC AMERICAN'S Industrial Digest

LIGHT-SENSITIVE GLASS

Forms Three Dimensional Image By Ultra-Violet Exposure

CONTAINING infinitesimal metallic particles throughout its mass, a new type of glass possesses photo-sensitivity to ultra-violet light, and offers new and interesting possibilities as a photographic and decorative material The images are formed in color and in three dimensions by exposing the glass to ultra-violet light through a negative, and subsequently heat-treating the glass

This glass, originally crystal clear, is not sensitive to ordinary visible light, and needs no dark room Exposure naturally depends upon the intensity of the ultra violet and the density of the negative, but apparently is short, being described as "momentary" The exposed glass is subjected to a temperature of about 1000 degrees, Fahrenheit (dull red heat) to develop the image Once developed, the image is extremely permanent and is free from the graininess encountered with some silver emulsions.

In addition to its obvious value in photographic work, the new glass, a development of the Corning Glass Works, is expected to have important applications in many decorative fields, as well as in making permanent records in a form resistant to both age and fire —*D.H K*

CARBIDE DIES

Cut Maintenance Time in Forming And Blanking Operation

APPLICATION of cemented carbide cut-out and cupping dies in a nine-stage progressive die set has increased runs on the rod bearings for socket tie rod assemblies from 200,000 to 2,000,000 before dies require reconditioning, an auto parts manufacturer reports Actually, it is claimed, even longer runs could be achieved before the carbide dies become dull.

The cut-out and cupping dies were formerly the most troublesome stages in the progressive set After about 200,000 pieces were run with the steel dies it was necessary to shut the machine down due to loading up of the cut-out die The die overhaul required about two hours, during which time the machine was idle After some three sharpenings, the cut-out die had to be replaced

To eliminate this bott'e-neck, first the cut-out die was changed to Carboloy cemented carbide Later, the high-speed steel forming die in the fourth station was also replaced with carbide Both the cut-out and forming dies are of exactly the same design as the respective steel dies, lubricant and machine speed (105 strokes per minute) were not changed

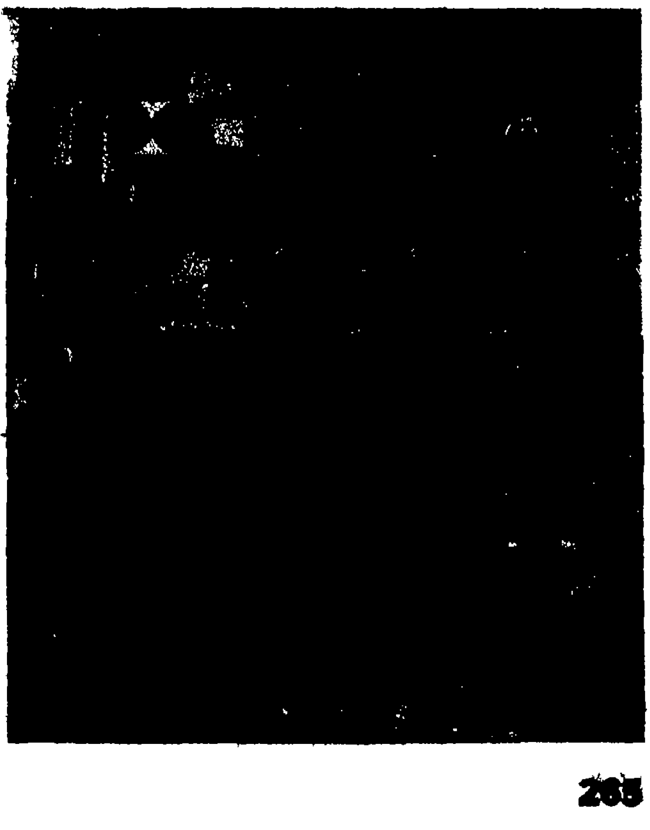
After more than a year's experience with the new dies, the manufacturer of those rod bearings, Thompson Products Company, now removes the die block for sharpening only after each 2,000,000 operations Up to the 2,000,000 mark, the carbide cutting-out die is not dulled They feel however that this practice gives them a longer total service life For that length of run, says the company, seven steel cut-out dies would have been needed

The carbide forming die has performed over 5,000,000 operations to date without requiring polishing

At a conservative estimate, 44 hours of maintenance time have been saved on a year's run of 5,000,000 tie rod bearings, through the use of carbides This is equivalent to an added production of some 315,000 pieces, according to the Thompson Products Company

At the first station of the die set, an oil groove is formed The stock is then successively blanked, given a glancing blow to separate the disks, and then given its first form-

Above: Carbide forming die (left), after more than 5,000,000 drawing operations, still needs no maintenance. Carbide cut-out die (right) is resharpened only after 2,000,000 operations



Right: Fourth and sixth stations of this nine-stage progressive die set are of cemented carbide (see arrows). The strip at bottom shows the sequence of blanking and forming the tie rod bearings

ing draw in the Carboloy die The fifth station is primarily for locating At the sixth station, the part receives the final draw, the bottom of the cup being re-struck Next, the center hole is pierced The piece receives a re-striking blow at the eighth station The ninth station is the Carboloy cut-out die The bearing material is cold drawn S A E. 1010 stock, 078 inch thick.

SPECIMENS PRESERVED

By Embedding In Solid Block of Acrylic

Embedding specimens in acrylic has often been under discussion as a means of preserving animal and soft tissues for long periods of time without their suffering loss of cover or shriveling away Rohm and Hass Company now offers a process developed by Dr Max M Strumia and Dr J Ivan Hershey of the Bryn Mawr Hospital in co-operation with this material manufacturer, which promises to meet all the conditions set up by professors, doctors, and students

The first step in this technique is the freezing of fresh unfixed organs or slices of organs in such a way as to cover them completely with ice The water is removed (to less than 1 percent) by means of sublimation of water vapor from the frozen state with the aid of a high vacuum and by condensation of the water vapor at —40 to —50 degrees, Centigrade

Water, in specimen is replaced with liquid acrylic, after which specimen is embedded in successive layers of plastics (above). Embedded specimen (below)

The spaces left by removal of the water from the specimens are filled under a vacuum with liquid acrylic monomer The specimen is then placed on a preformed base of clear acrylic and covered with successive layers of monomer which has been heated until it is partially polymerized This process is continued until the tissue is completely embedded in acrylic

The container holding the monomer and specimen is then placed in an oven at 45 degrees, Centigrade until it is completely polymerized into a solid crystal block of acrylic It only remains to cut the block to the desired shape and size and polish —*C A B*

FIRES IN COTTON

Prevented By Dusting Bales With Sodium Bicarbonate Powder

Baled cotton in storage presents a serious protection problem because the fibers are easily ignited, and flame spreads rapidly, eventually producing smoky burrowing fires that are difficult to extinguish Preliminary tests at an experimental station of the Associated Factory Mutual Fire Insurance Companies' laboratories show that by dusting the surfaces of cotton bales with sodium bicarbonate powder, ignition from small external sources such as sparks or match flames can be prevented When exposed to heat under such conditions, the sodium bicarbonate powder releases an inert gas that reduces the oxygen content to a point where ignition does not occur

Cotton bales dusted with sodium bicarbonate are not subject to the characteristic surface flash fires which usually occur and quickly involve all the exposed bales in the storage unit. The powder is not expected to interfere with manufacturing as it will be blown from the fibers in the normal preliminary processing And it has no abrasive or corrosive action on bearings or machine parts

CRESCENT FLUORESCENT

Permits Novel Decorative Lighting Effects

Providing more light than a 50-watt incandescent lamp, but consuming only about one third the power, a new semi-circular fluorescent lamp called Circlarc, is designed for table and floor lamps, for wall and ceiling fixtures, and for interiors where the lamp itself will add a decorative dash.

Tubes in tandem form fluorescent ring

This Circlarc will permit unusually great flexibility of uses. For example it now is possible to use a standard curved fluorescent lamp in a convenient pinup fixture over the bed or in a wall bracket. A pair of these fluorescents can girdle a column, and a single tube in a desk lamp tucks neatly under a half-moon shade When twinned, they will form a circle in floor or table lamps

The Circlarc, product of Westinghouse Electric Corporation, is an 18-watt tube curved like a crescent. It has a useful life expectancy of 2500 hours at three hours average burning for each start, two and one half times longer-lived than a 50-watt incandescent bulb Two-pin plastics bases at each end of the crescent connect the lamp to the electric circuit

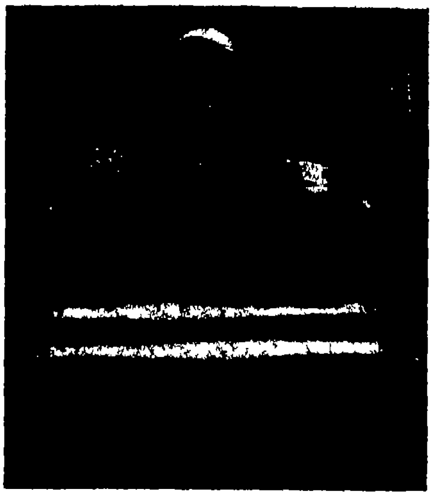
PLASTICS ALLOYED WITH SYNTHETIC RUBBER

Combines Advantages of Both Materials

Greater use of synthetic rubber in the manufacture of plastics can be expected to develop new, large-scale production of consumer items in which advantages of both materials are combined Alloyed with synthetic rubber, plastics can be used to make such new and varied items as kitchen floor tiling so tough, resilient, and resistant to oils and grease that it can serve also fo garage floors, tissue-thin, transparent food wrappers that will not crack under freezing temperatures, and fenders that will bounce back to their original shapes after being bumped So far, the Buna-N types of synthetic rubber have shown far more versatility in connection with plastics manufacture than any other type

As an alloy for polyvinyl chloride, only one of 30 basic resins used in the manufacture of plastics, 40 to 60 million pounds of Buna-N types of synthetic rubber ultimately will be required annually, according to *The Lamp*, publication of the Standard Oil Company (N J).

In the field of thermosetting plastics, introduction of synthetic rubber not only will toughen the product, but will increase its color range Heretofore, many of the thermosetting plastics lost their essential qualities when heavily pigmented Blended with synthetic rubber, it is now possible to produce heavily pigmented thermosetting plastics of good physical characteristics in a wide variety of colors



This tough film is calendered from a vinyl-Buna-N compound on a rubber mill

TRUE CARBURIZING

In Oxygen-Activated Cyanide Bath

A NEW TYPE of cyanide salt bath for case hardening of steel parts, which overcomes most of the previous objections to cyaniding, has been developed by Park Chemical Company and applied by Michigan Steel Processing Company with excellent results

The distinctive features of the new bath are gas activation of the bath and complete water-solubility of the salt adhering to the work Conventional cyanide baths have employed salts of barium, strontium, calcium, and so on, as activators, and these salts produce insoluble compounds in the bath that are difficult to remove from the heat-treated parts

Although the salt bath is of the cyanide type, the case produced is a true carburized case, rather than a cross between a carburized and a nitrided case as is normally produced in a cyanide bath. Activation of the bath with oxygen gas is responsible for this difference The same bath can be used for both carburizing and cyaniding, serving the former purpose when operating with the gas activating agent, and the latter without the gas The salt melts at 1150 degrees, Fahrenheit, and works well within the range of 1300 to 1750 degrees, Fahrenheit

When operated at 1700 degrees, Fahrenheit, a case of 0 015 inch is produced in the first hour, 0 010 additional the second hour, and 0 005 inch more in each succeeding hour —*F P P*

NYLON FAUCET WASHERS

Last Longer, Function Better Than Those of Rubber, Fiber

DRIPPING faucets may soon be a nuisance of the past, thanks to new injection-molded nylon faucet washers that offer a number of advantages over the traditional washers of natural and synthetic rubber or fiber

The advantages of these nylon washers, that are being produced in eight diameters by Atlantic Plastics Inc , are readily seen when the properties of this particular plastics are set up against the operating conditions to which washer materials are subjected.

1 Washers undergo constant intermittent service in both hot and cold water, a condition that nylon is able to withstand because it expands and contracts very little under thermal change

2 Nylon's toughness resists the cutting and wear to which washer material is subjected when forced against seats roughened by the action of mineral salts

3 Washers must withstand water pressure against smooth faucet seats Nylon's coefficient of friction well fills this requirement

4 Nylon possesses the right balance of flexibility and rigidity for a washer material, which must conform to surface irregularities and permit hard foreign particles to imbed themselves in the washer rather than hold open the valve

5 Continued exposure to elevated temperatures has been found to shorten the useful life of many rubbers and thermosetting materials that have been used as washer material Nylon, however, does not suffer in this way, having a high heat-resistance which keeps it from hardening when exposed to high temperatures —*C A B*

RADIO GRILLS ASSEMBLED

By Electrically Heated Dies On Standard Hydraulic Press

PROVIDING a simple answer to the problem of obtaining high output rates with accurate control and ease of operation in the assembling of metal screens to plastics radio grills, standard hydraulic bench-type presses, as produced by the Colonial Broach Company, are in use at the plastics plant of the Ford Motor Company

Currently produced are some 300 grill assemblies per hour on three presses, equipped by Ford with special upper and lower dies The upper die, of cast iron with some 24 projecting "fingers," is electrically heated with a thermostatically controlled resistance coil.

The metal screen is merely laid

One such press can turn out 100 metal-plastics grills per hour over the plastics grill which is laid in the lower die The control lever is then thrown on the machine, causing the upper die to move down until the heated fingers have pressed the screen into the plastics to a depth of 1/16 of an inch. The heated fingers plasticize the grill at these points, so that the screen is well embedded

The head is then retracted and the completed assembly removed, the plastics solidifying to hold the screen securely at the 24 points of attachment.

Important advantage of using a hydraulic press here is that the pressure is "cushioned," protecting the plastics against shock Also, the stroke of the machine is accurately controllable by means of the standard adjustable stop on the press

SYNTHETIC ESTERS

Replace Natural Waxes In Many Applications

Castor oil, whale oil, and palm leaf oil are the raw materials for a series of wax-like esters which are now produced in England and will soon be manufactured here

Abril Corporation, maker of these synthetic waxes, now markets 32 different ones as standard items They vary in melting point (43 to 285 degrees, Centigrade), acid value, color, and other properties, thereby duplicating the whole range of natural waxes They are soluble in petroleum solvents, insoluble in water, and compatible with all paraffin and vegetable waxes They can also be emulsified

It is as components of wax polishes that they expect to find their widest market Other applications are as ingredients in carbon-paper coatings, printing inks, cosmetics, candles—in short, practically all wax uses

Of particular interest is the high-melting wax Melting considerably above the boiling point of water, this wax may prove ideal in coating paper containers for hot beverages and foods —*H C E J*

SPRAY PATTERN

Of Fuel Injection Nozzle Studied By High-Speed Photography

Ultra high-speed photography using stroboscopic light makes possible the study of hitherto unknown fuel spray patterns of injection nozzles in internal combustion engines by "stopping" the fuel particles at any desired point Revealing fuel spray characteristics, this technique being employed by the Texas Company permits petroleum technologists to determine whether spray patterns are correct for the most efficient combustion It is anticipated that by directly correlating these patterns with the nozzle designs, more efficient and reliable engine performance can be achieved

Already, in an analysis of aircraft engines experiencing dilution and hard starting, this method has proved of value, determining that these troubles were due to poor atomization, irregular fuel injection, and thus incomplete combustion With the new data, it became possible to make recommendations which assure improved combustion

The fuel spray photographs can be taken in one to two millionths of a second With this very short exposure time, the rapidly moving fuel spray can in effect be "stopped" at any point and considerable detail is revealed concerning the general shape of the spray and the direction and distribution of the fuel particles The stroboscopic light is synchronized with the fuel pump and the flashing circuit is arranged to permit either single or continuous shots These shots show the spray pattern at any desired stage of its development from start to finish in this injection cycle

Fuel spray is photographed with an exposure time of one micro-second

SILVER NITRATE CRYSTALS

Mass-Produced By a New Continuous Process

Replacing the old and picturesque —but slow—method of producing silver nitrate crystals by evaporation in open porcelain dishes, a new process produces crystals continuously, and dries them in a few minutes

As the first step of the new process, developed by Eastman Kodak Company, several pieces of silver, 99 97 percent pure, are dissolved in nitric acid The resulting greenish liquid goes into storage tanks, from which the solution is pumped slowly into crystallizers In the crystallizers, 1000-gallon stainless steel tanks, the liquid is constantly stirred by circulating pumps This stirring, and the constant addition of fresh silver nitrate solution re-

Producing a continuous stream of silver nitrate crystals, the new process (left) replaces the slow open-dish evaporation method (right) sult in the formation and growth of silver nitrate crystals in the lower part of the tank. Soaking wet and resembling salt, the crystals then are drawn from the tank through a pipe and poured into perforated stainless steel baskets

The baskets, containing from 60 to 70 pounds of crystals, are whirled, to drive off most of the moisture

The crystals are then redissolved in distilled water, and again they go through the same crystallizing steps After the wet crystals come from the crystallizers the second time and have been whirled until they are only slightly damp, they are dumped into a rotary drying drum

At the other end of the revolving drum the crystals, to be used largely by the photographic industry, pour out completely dry

WELDED NUTS

Insure Solid and Accurate Assembly of Car Frames

Ingenious yet simple, a manufacturing process which not only increases the security of attachment of automobile or truck bodies and steering gear assemblies to chassis frames, but also reduces manufacturing cost and chances of misalinement, consists of projection welding previously threaded nuts to frame side rails The nuts have four projections formed on the attachment side of the head during the forging process To attach a nut to the frame, it is placed, with projections up, in the lower die of the platen of a Progressive Welder Company press welder The side rail is slid along, until a registering hole in the channel drops over the shoulder on the nut. The upper platen is brought down, one shot of current is passed through the electrodes, fusing the projections to the side rail, and the job is finished.

Advantages over the previous method of either arc welding or mechanically attaching such nuts, are greater security of attachment, accurate alinement, and considerable increase in output, particularly since nuts do not have to be retapped after welding

SCREW-TYPE TRANSMISSION

Enables High-Speed Shifting Without Power Lag

Able to shift into any one of four speeds in one second, and readily adaptable to "push button" control, a new type of transmission was developed during the war for use with a multiple-speed high-altitude supercharger, and is now available for use in ground and marine transport, or in stationary powerplants requiring quick changes in speed

The transmission, having only half as many parts as present automatic types, may be shifted under any condition of speed or load, without the temporary lag or loss of speed and power now encountered in shifting with a conventional transmission The mechanism requires little or no adjustment for wear, shifts more easily, and automatically synchronizes gears before each shift In motor vehicles, it substantially reduces the tendency of wheels to spin on icy or slippery roads

Known as a "screw shift" type, the transmission, developed by the Curtiss-Wright Corporation, has helical or spiral grooves cut in the main shaft which is the center of the mechanism Action of the shift lever moves selector gears forward or backward along this spiral until they synchronize with the desired gear In this way there is a constant torque or twisting force on the drive shaft and all shifting is done in a straight forward or reverse motion, unlike the conventional "H" type shift

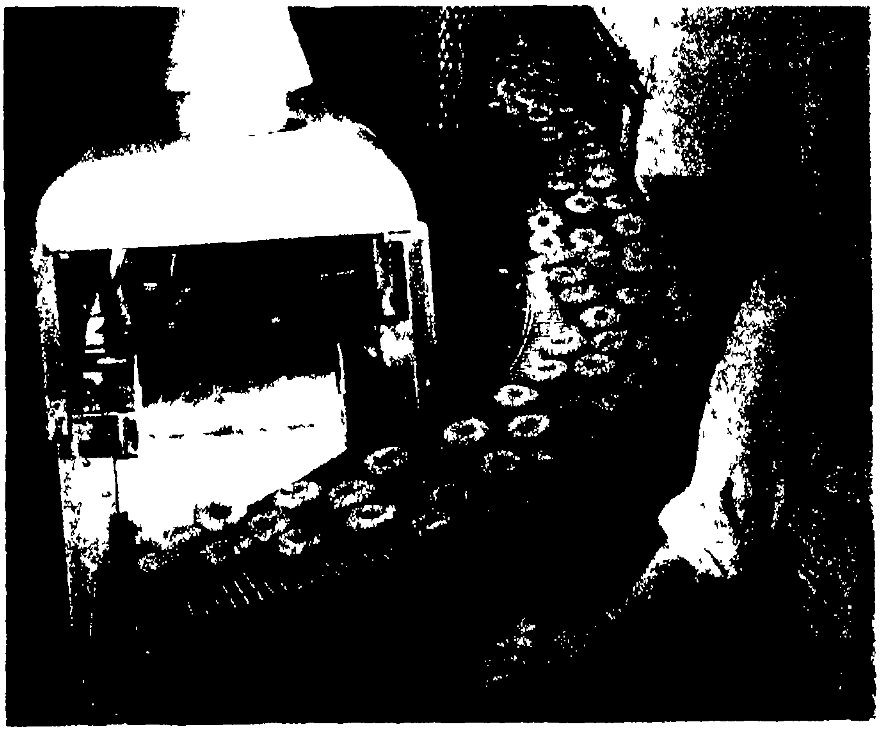
WIRE CONVEYOR BELT

Can Turn Sharp Corners, Is Suitable as Cooling Line

Able to turn corners without tipping—describe a complete circle if need be—move a product uphill or down, or horizontally straight ahead, a steel grid conveyor belt has been designed for industrial process lines with special space requirements The new conveyor's open construction permits the air circulation required for cooling a light-weight product while in motion A section two feet wide weighs only three pounds per linear foot and is made in bright, galvanized, tinned, or stainless steel wire as may be most desirable to meet special conditions in manufacturing operations Thus the cooling belt lines of a baking plant, for example, may be designed to hug the walls, turn as many corners as necessary, and to stack flights to ceiling heights with as little as ten inches between loaded faces There are no lubrication problems and, because steel wire is used no difficulties result from fats, oils, greases, fumes, or heat Known as "Flex-Grid," this wire-built belt is manufactured by Cyclone Fence Division of American Steel and Wire Company

Necessarily, Flex-Grid belts must be assembled to meet the needs of the individual user's design, taking into consideration such problems as service life, speed of transfer, weight, power required to operate, and slippage As the belt is assembled from individual straight, stiff wires, it is possible to compensate wear factors by replacing one or more links at a time—a simple and easy operation.

The belt is made from nine-gage steel wire assembled on one half inch centers and is available in standard widths, from six inches to two feet, in straight lengths or curved sections Normal construction involes lengths up to 40 feet



Open construction of the wire conveyor facilitates cooling of articles in transit

New Products

FLOW PRESSURE FANS

Claimed Sturdy, Compact, And Efficient

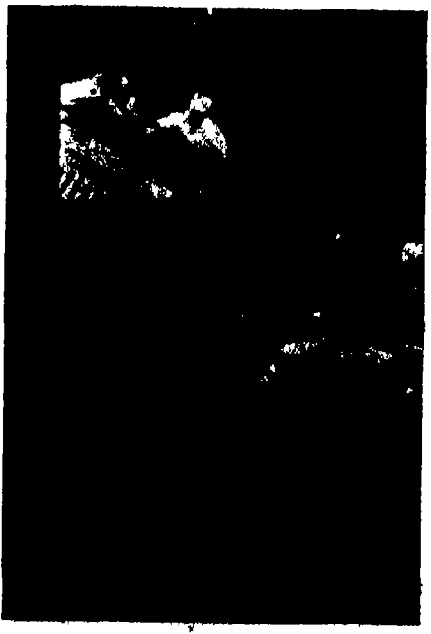
Designed for either vertical or horizontal operation, a new line of flow pressure fans are said to have high mechanical and static efficiency against wind and duct systems Compact in design and sturdy in construction, these new fans, products of the Westinghouse Electric Corporation, feature also low weight, straight air flow, and simplified mounting Sizes of these fans run from 18 to 72 inches, with displacements of from 2000 to 115,000 cubic feet per minute

Two basic types of these Axiflo Fans, as they are called, are available the straight-through type, or the conventional elbow type Both types can be had with either a three-bladed aluminum wheel, or an eight-bladed steel wheel

SLIDE PROJECTOR

Casts Clear Image on Screen In Partially Lighted Room

Ending the need for a completely darkened room during the showing of slides or transparencies, a new slide projector throws a clear image on the screen even when the room is sufficiently well lighted to permit the audience to take notes Secret of the ability of the Eastman Kodak Company's new Master Model Kodaslide Projector to produce clear screen images under such conditions lies in the fact that the projector delivers more light to the screen than any other projector ever created for two by two inch slides and transparencies This is made possible through the use of a 1000-watt projection lamp and extremely "fast" lenses, coated with a microscopically thin layer of magnesium fluoride to increase light transmission

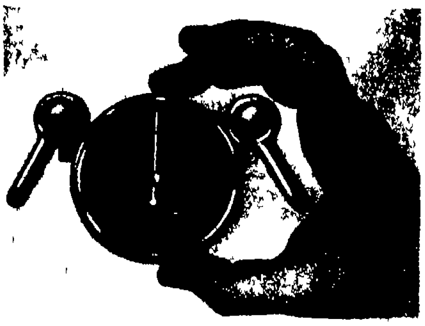


A very "fast" coated lens makes possible the unusually brilliant image

SMALL DYNAMOMETER

Measures Tension in Confined Areas

To measure tension or forces in those "tight" spots found in many types of mechanical assemblies, a miniature dynamometer has been developed that is said to be the smallest of its kind The case measures three inches in diameter, the instrument weighs but one pound Available in 100, 250 and 500 pound capacities, it has an unbreakable lucite crystal and red maximum hand The dial of the instrument, product of W C Dillon and Company, is black with etched silver numerals



In 100, 250, or 500 pound capacities

WELDED HAND TRUCK

Has Built-In Lift Bar To Simplify Loading

An all-welded hand truck, featuring a special prybar which simplifies lifting and moving of heavy crates weighs only 60 pounds and is constructed primarily of steel tubing Heavy duty, roller-bearing wheels, of as small diameter as possible, are used on the front end of the hand truck where the burden of the load is balanced, and casters are used for the rear wheels

The truck, known as the Whiting Wheeler, approaches a case resting flat on the floor with the "prybar," pointed toward the floor and it slips under the edge of the case with very little effort The prybar then is pushed down with one foot, thus raising the case about an inch and a half with a lever ratio of 10 to 1 At the same time the handle of the truck is raised, increasing the lift, and permitting the edge of the case to go over the top of the front set of rollers At this point it is necessary to give the truck only a quick thrust forward to complete the loading

It is claimed that the forward movement of the hand truck, a product of the Whiting Engineering and Manufacturing Company, will not noticeably advance the crate, and consequently there is no necessity for backing the crate up against a wall or other immovable object The truck has a capacity of 600 pounds

Courtesy Lincoln Electric Company

To load, the operator pushes the hand truck under the edge of the case which is held off the ground by the prybar

OSCILLOSCOPE CAMERA

Takes Still or Continuously Moving Film Record of Trace

Equipped for mounting atop standard laboratory oscilloscopes, a 35-mm camera, which makes still or continuously moving film records, photographs high-speed phenomena, as well as very low-speed phenomena (too low for visual continuity) It is also used for quantitative studies of oscilloscope traces for record purposes, and for tests using new multiple-beam tubes It is said that by using the sweep circuit of the oscilloscope in conjunction with the variable speed drive, the speed of the trace photographed is limited only by the writing speed of the oscilloscope itself By adjusting the speed of the film, the camera records each successive sweep across the film without the use of a shutter If desired, the moving film can be used as the sweep, giving a continuous recording along the film The film rate is continuously adjustable from one inch per minute to 3600 inches per minute (or five feet a second)

Continuously variable oscilloscope photography is the type most desirable for many applications, but provision is made for single exposures by a

The camera, operating through a periscope arrangement, sits on top of the oscillograph. Control unit is at right

shutter with speeds of one second to 1/400 of a second Its frame size can be adjusted up to double 35-mm size A positive interlock keeps the shutter open for continuous recordings

For continuous strip photography, the rate of film movement is governed by an electronic control giving a speed variation of 60 to 1, continuously adjustable throughout this range by means of a calibrated dial A clutch is provided on the camera for an additional 60 to 1 gear ratio This clutch, which may be shifted while the camera is photographing, is operated by a simple push-pull knob Thus it is possible to have the camera running, for example, at 60 inches per minute, and, by means of the clutch, shift it immediately to 60 inches per second

The Oscillo-Record Camera, as it is called, takes standard 100-foot rolls (a satisfactory length for most applications) of 35-mm film, or film in standard 400-foot or 1000-foot magazines With the 100-foot rolls, the camera operates from 20 seconds at the maximum speed, to 20 hours at the minimum A footage indicator shows the number of feet film exposed

As a solution to the problem of mounting which has hitherto handicapped the use of a camera with an oscilloscope, this camera, manufactured by the Fairchild Camera and Instrument Corporation, is easily set up on top of the scope, out of the way of the controls, with a simple mounting arrangement which also automatically insures correct focus Provision is also made for tripod mounting The unit is designed to fit five-inch ray tubes, and an adapter is available for three-inch tubes The operator may view the readings of the scope while they are being photographed for permanent record

Provision is made for recording on the film any hand-written data, by means of an illuminated card supplied with the camera Thus, the data becomes a permanent part of the film record, and danger of loss or mixup is obviated

SCREW ANCHOR

Of Pleated Plastics Holds Screw Firmly in Stone or Plaster

SIMPLIFYING the anchoring of screws in such materials as plaster, brick, stone, concrete, glass, and so on, a new type of plastics screw anchor may be used with either wood or lag screws Overlapping internal and external slits along the length of the anchors result in a "concertina-type" expansion which develops holding power far beyond the requirements of most applications

The anchor is slightly larger than the hole into which it is to be inserted Thus, when it is forced into the hole, those "concertina" slits compress, when the screw is driven into the anchor, the slits expand, firmly holding the screw in the hole Produced by Holub Industries, Inc , the anchors are available in seven common sizes and in various lengths

The plastics of which the anchor is made has great impact and tensile strength, and is unaffected by weather, water, or acid It will withstand temperatures from 78 degrees below zero, to 180 degrees above zero, Fahrenheit, and has good electrical insulating properties

PLANT LAY-OUT TEMPLATES

Of Acrylic, Serve as Negatives in Blue-printing Arrangement

PROVIDING permanent facsimilies, accurately scaled, of machines and equipment, new acrylic templates for plant lay-out are made from sheet-Plexiglas, one surface of which is coated with a photosensitive emulsion Scaled drawings of machinery and equipment are reproduced as negatives on this emulsion Then, by carefully cutting the plastics around the outline of the reproduced drawings, accurately scaled templates are produced, on whose under-sides are diagrams in negative of the machines which they represent

These templates are used in conjunction with a thin, transparent plastics mat which is ruled off into quarter-inch squares (each square representing one square foot) On this mat the outlines of the plant area, along with locations of conduits, traffic aisles, tool cribs, material bins, and so on, are drawn with grease pencil

To make a blue-print of a proposed or final lay-out, a smooth magnetic-metal sheet is overlaid with a special printing paper On top of this is placed the mat representing the plant area The templates of machines and equipment are then set on the mat The attraction for the metal plate of small, circular Alnico permanent magnets fixed to each template, hold the template securely in any desired position

According to the overall size of the lay-out one or more quad-lamps with reflectors are used to expose the paper Development of the pattern is accomplished in about three minutes over an ammonia vaporizer The resulting print shows, in blue on white, a positive reproduction of each piece of machinery and of the other floor-plan details, super-imposed upon the scaled floor area

This set-up, developed by John Hill Layouts, can conveniently accommodate more than 40,000 square feet of floor area to the quarter-inch scale

CARTON MARKER

Features High Rate of Speed And Simple Operation

AUTOMATICALLY imprinting flat-folding cartons with code-dates, control numbers, or any similar data, a new coding machine is said to mark as many as 4500 cartons per hour Called the Cartoncoda, this machine is adjustable to accommodate a wide range of carton sizes, and requires no skill to operate The operator simply loads unmarked

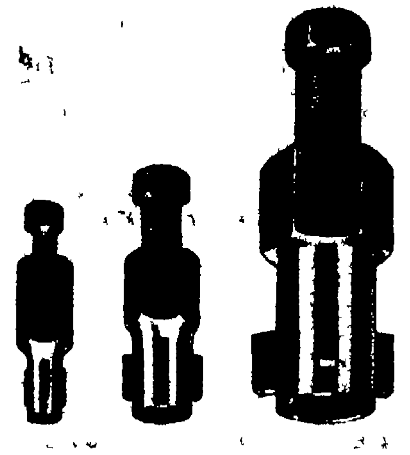
Small circular magnets hold the plastics template fast to the lay-out mat cartons onto the infeed magazine, which accommodates a stack 12 inches high. Each carton is fed to a conveyor belt which carries it to the marking stations where the code is imprinted Then the marked carton is deposited on a return conveyor belt which leaves the carton within easy reach of the machine operator

This machine, which is a development of Adloph Gottscho, Inc, uses ribbed-base rubber marking dies which are easily changed when a new imprint is wanted The unit is small and compact, occupying a floor space only 18 by 40 inches It is powered by a ¼ horsepower motor operating on 110-volt, 60 cycle A C

INTERNAL PIPE WRENCH

Sturdily Built, Removes Broken Pipe or Close Nipples

CLAIMED to have sufficient strength to strip a thread without losing its grip, a new type of internal pipe wrench is designed for quick and easy removal of broken pipe, close nipples, and gate and globe valve seats It consists of a screw-type mandrel that forces outward three gripping dogs until they bite firmly into the inside of the pipe Then, with the application of any standard wrench, the pipe or nipple is quickly turned loose and removed



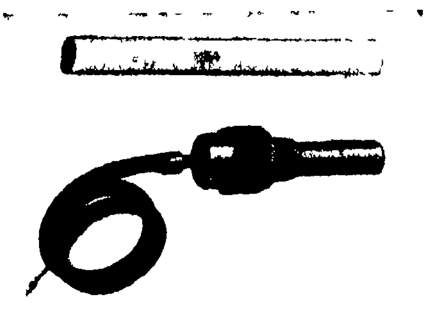
Turning mandrel forces out gripping dogs

Marketed as the B and D Internal Wrench, it is designed for speeding up and simplifying maintenance work wherever pipe is used It may be used on nickel, chrome, or brass fittings The gripping dogs are made of hardened tool steel and body is high tensile steel alloy

THERMAL LIMIT SWITCH

With Wide Control Range Operates Under Severe Conditions

GIVING warning when excessive temperatures are reached in automotive gear boxes, railway journal boxes, or other similar units, a new thermal control and limit switch is easily installed The switch serves also as an indicator of high or low temperature in fluids under pressure, or of temperatures of static fluids, such as oil in crank cases and water in cylinder blocks, or of exhaust stack temperatures Its thermal control range lies between —60 degrees and +600 degrees, Fahrenheit, and its amplitude of operation is plus or minus 3 degrees, Fahrenheit The device, called Plug-Stat, operates on 28 volts, two amperes, either A C or D C, and is available with either normally open or normally closed circuit Manufactured by Control Products Inc, the switch weighs 67 ounce and is hermetically sealed It is said to be the smallest thermal limit switch now in production, and is designed to operate under conditions of severe vibration, dirt, and abuse



Thermostat is smaller than a cigarette

DIELECTRIC HEATING TUBE

Features Rugged Construction And Easy Installation

DEVELOPED for industrial heating applications, a 2500-watt oscillating tube is designed for use in dielectric heating of plastics preforms, electronic bonding or gluing of laminated plywood, and sealing of plastics materials such as synthetic rubber and cellulose acetate Two tubes in a coupled circuit will give a power output of four and one half to five kilowatts at frequencies up to 50 megacycles.

Radial cooling fins with large surface areas and unrestricted air flow combine to provide highly efficient forced-air cooling of the anode The minimum air flow for cooling the tube, designated type 7C25, is 150 cubic feet per minute Ruggedly constructed, with flexible leads allowing safe and easy installation, these tubes, developed by the Federal Telephone and Radio Corporation, have a maximum plate voltage of 4500 volts With a thoriated tungsten filament the tube operates with a filament voltage of 11 volts and current of 27.5 amperes The tube measures three and one half inches in diameter and seven inches in height with flexible tube leads six inches in length

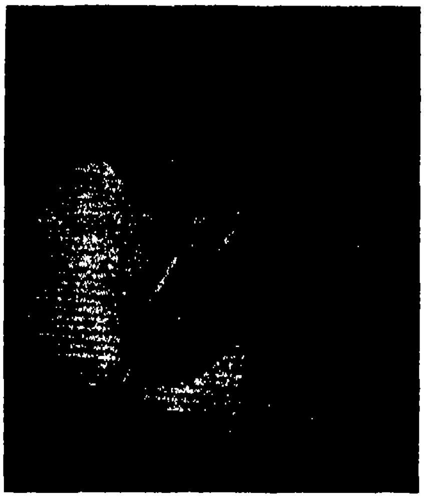
POCKET SIGNAL GENERATOR

Has Wide Frequency Range Output To Speed Radio Servicing

PRODUCING radio, intermediate, and audio frequencies (from approximately 2500 cycles through 20 megacycles) simultaneously, a pocket-size signal generator is said to perform the necessary functions of large, high-priced generators, and to speed up radio servicing routines

Working on 110 volts, either A.C or D C, the Signalette, as the device is called, has an output which is modulated by 60 cycle supply when used on A C line, the modulation is not present when used on D.C supply Checking receiver sensitivity, alining intermediate frequency stage, alining radio frequency stage, peaking auto radio antenna, checking auto radio shielding, locating breaks in concealed wire, checking audio amplifier gain, and localizing trouble in receivers (signal tracing) are among the instrument's functions

Approximately 9¼ inches long, 1½ inches in diameter, and weighing only nine ounces, the instrument has an adjustable output attenuator and is completely isolated from power source for use in testing A C-D C type receivers



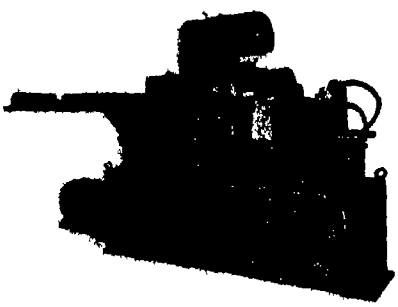
Signal generator is 9¼ inches long

The signal generator, product of Clippart Instrument Laboratory, Inc., uses a fundamental frequency of approximately 2500 cycles, with a separation of 2.5 kilocycles per second between successive harmonics When the multivibrator output is listened to on the loudspeaker of a receiver under test, the successive harmonics tend to blend together into a continuous harsh, raspy tone, which can be easily identified

PIPE CUTTING MACHINE

Automatically Cuts Precision Lengths at High Speed

HIGH PRODUCTION and accuracy of cut lengths of pipe and tubing are claimed as the features of a new, fully automatic cut-off machine The work is fed to the machine by motor driven rolls through a hollow spindle, and against an adjustable receding target stop A rotating head automatically cuts the work to required length producing a square face and holding end-to-end dimensions within a few thousandths of an inch of requirements The head



Cuts up to 1500 pieces of pipe per hour

is tooled to produce a clean cut with a minimum of burrs raised

Production of up to 1500 pieces per hour is possible, depending on composition of the stock, wall thickness, and diameter The fast operation of this machine is due to the rapid continuous machine cycle Once the machine is started, the operation is continuous until the machine runs out of stock The time to complete an entire machine cycle is only one and one half seconds

Fully automatic, the machine, produced by the Pines Engineering Company, Inc., is designed for general duty, and is quickly adjusted to produce cut-off pieces to suit length and diameter requirements The spindle inserts and collets may be changed in a few minutes, and the tool holders permit rapid adjustment to meet conditions of diameter Either parting tool bits or rotary cut-off disks may be employed depending on the job

Uncut stock may be manually placed on the feed rolls or a power driven conveyor with selector may be furnished to supply the feed rolls direct from storage rails One operator can attend several machines

HYDRAULIC FOOT PUMP

Small and Light-Weight, Exerts Pressure of 1500 Pounds

Compact and small, a new light-weight hydraulic foot pump has a usable oil capacity of 15 cubic inches, and a working pressure of up to 1500 pounds per square inch The oil is contained in a sealed reservoir requiring no vent, thus allowing the pump, produced by the Lyon-Raymond Corporation, to be mounted in an offset position if desired The pedal return spring is built inside the pump body, and the release is controlled by slightly raising the single pump pedal Total weight of the pump is only 13¼ pounds

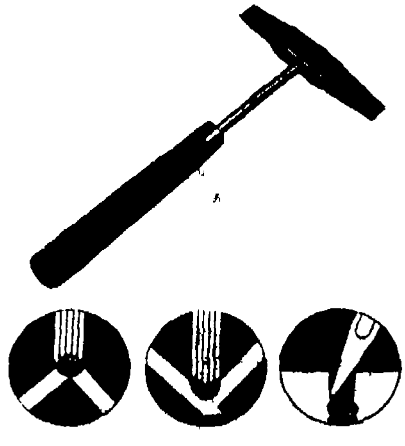
Pressure released by raising pump pedal

WELD CLEANING HAMMER

Has Five-Segment Head For Equal Impact Over Uneven Surface

Said to give cleaner welds, faster cleaning time, and greater all-around efficiency than the common single-head slag hammer, a new weld cleaning hammer works on an entirely new principle Five separate pick-pointed hammer heads—each free to slide ⅜ inch —are mounted on a single hammer handle When a blow is struck, each of the five head segments strikes with equal impact at five different points, regardless of surface contour These free-sliding head segments actually wrap the force of a blow around a convex weld bead or follow the contour of a concave weld fillet or the irregular surface of the hard-to-reach crevices such as are found in weld bead craters and deep groove multi-pass welds

The head segments are of tool steel, hardened and tempered throughout They can be resharpened on a grinding wheel in the same manner as an ordinary chisel The shank is of ⅜ inch hard drawn mild steel Both head segments and shank are plated with cadmium to retard rusting and to keep weld splatter from fusing to these parts The extra-long hickory handle of this tool, called the Multi-Pic by its manufacturer, the Bernard Welding Equipment Company, assures perfect balance and insulation against shock The handle is fitted with a lock-pin to prevent turning under heavy usage

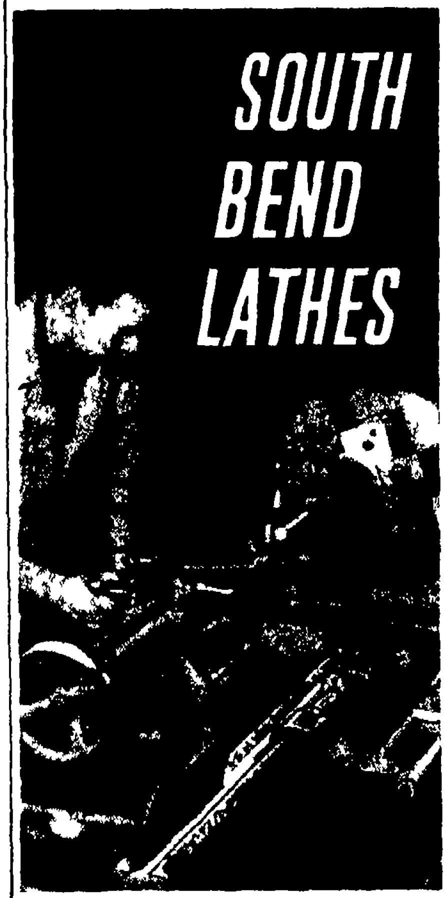


For faster, more efficient weld cleaning

PHOTOELECTRIC RELAY

Operates Over Long Distances In Spite of Rain, Fog, or Snow

Even when operated at distances up to 1000 feet, a new photoelectric relay and light source operating on the modulated light principle has sufficient sensitivity to prevent false operation due



Simplify Precision Work

It is more than the dependable accuracy of South Bend Precision Lathes that makes precision work easier A wide variety of exacting operations become routine—and with a minimum of set-up time—as a result of their versatility Conveniently placed, easy-acting controls make machine handling effortless The operator's attention is on the work instead of the lathe Regardless of whether it s precision toolroom work or production work, you'll find that South Bend Precision Lathes will help simplify it.

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to rain, fog, or snowfall Applications include traffic control, counting and limiting, and protection of restricted locations

The light source contains a lamp, transformer, and motor-driven slotted disk which interrupts, or modulates, the light beam at about 900 cycles per second The photoelectric relay, a product of the General Electric Company, has a tuned circuit which allows the relay to be responsive only to a light beam modulated at this frequency It is not sensitive to changes in natural or artificial illumination The light source has an infra-red filter which removes most of the visible light from the beam

SOAP DISPENSER

Operates Automatically When Hands Break Beam of Light

Pouring soap automatically into hands as they are brought beneath the spout, a liquid soap dispenser is especially well suited for use in hospitals and aid stations Operating by means of a photoelectric relay, the dispenser has no valves or handles to be worked Hands placed beneath the spout interrupt a light beam, activating the relay which controls the pouring mechanism The flow of soap ceases as the hands are withdrawn

Hand at spout starts flow of soap

The unit, manufactured by E J Scarry and Company, measures 8½ by 7¼ by 18 inches, and operates on a regular 110-volt, 60 cycle power line

SOLDER FEEDER

Attaches to Standard Soldering Iron to Free One Hand

Clamping on to any standard electric soldering iron, a device which smoothly feeds solder at the touch of the fingertip, frees one hand to manipulate parts, pliers, or screw driver By feeding the proper amount of solder at the right time and place, the Solder-Matic, as the device is called, eliminates molten solder drippage, improving quality of workmanship, and enables the operator

Solder is fed at touch of finger

to do a better job in crowded spots or awkward positions.

Solder in short lengths, in small coils, or fed from a spool as large as 25 pounds can be handled by the new attachment, product of the Nelpin Manufacturing Company. It takes solder from 1/16 to 3/16 inch in diameter, and feeds up to 3/16 inch per stroke. Screw adjustment of the stainless steel nozzle guides solder where it is needed, regardless of the size or shape of the particular soldering tip being used.

SAFETY POWER CABLE

Non-Sparking in Short Circuit to Lower Mine Explosion Danger

To aid in the prevention of coal mine explosions, a new cable that will not spark when short circuited has been developed by electrical engineers. The new feature of the cable is a fine strand of copper wire embedded between the inner and outer layers of insulation. In the event of damage to the insulation the fine wire catches incipient current leakage before an arc can occur, and carries it to a sensitive circuit breaker which cuts off the power.

The cable was developed jointly by engineers of United States Rubber Company and Leonard Wilson of Kenilworth Mines. It is expected to eliminate a common source of danger in coal mines. This type of cable is used to carry power to heavy equipment employed in digging and transporting coal. The cable, trailing on the ground, is in constant danger of being damaged.

TEMPERATURE RECORDER

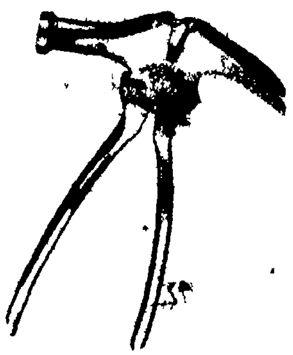
Is Small, Light Weight, and Shock-Resistant

Intended for use in the many applications where an easily portable temperature recording instrument is necessary, a miniature shock-proof temperature recorder is particularly suitable for use in trucks, railroad cars, and airplanes in transit, as well as in other operations where vibration is encountered. Because of its small size and portability, it is also useful for checking refrigerating, heating, and air-conditioning equipment. The instrument is available in two forms: the single-pen recording thermometer for recording temperature only, and the two-pen temperature and time-operation recorder, which charts the running time of refrigeration motors, for example, in addition to recording temperature. Simplicity of design and construction ensures accuracy in recording. A special transparent, unbreakable plastics front permits full view of entire chart and pen-arm. Pen-arm is "jiggle-proof," and thus temperature record is unaffected by vibration. The instrument, developed by the C. J. Tagliabue Manufacturing Company, is available in models to operate in a wide variety of ranges. Chart drive is a seven-day spring-propelled mechanism with charts of 24- or 72-hour duration. Each recorder is enclosed in an aluminum case and the overall dimensions are 5¾ inches square, 4¼ inches deep, and total weight is less than 3½ pounds.

FENCE TOOL

Combines Hammer, Ripper, and Pair of Pliers

Eliminating the inconvenience of carrying a heavy bag of tools through the fields, a light, compact implement is no larger than a small hammer, yet it splices, cuts, and stretches wires, and pulls nails and staples. It is a combination hammer, ripper, and pair of pliers. Easier to use than ordinary fence tools, the manufacturer, the Hercules Forge Corporation, also claims that it does a neater, stronger, and more permanent job than heretofore possible.



Weight—1½ pounds

In appearance, the Fence Master, as it is called, is much like a combination claw hammer and pair of pliers. It is made of heat treated, drop forged chrome-molybdenum steel. Finish is nickel plate, weight is 1½ pounds, length 10¼ inches, width at hammer and claw end, 5⅛ inches.

FLY ASH COLLECTOR

Of Aluminum Tubing Features Small Diameter For High Efficiency

A departure from conventional tubular-type dust collectors, a new unit uses a cast aluminum tube only three inches in diameter. As a result, efficiency is high because of increased centrifugal forces. Small diameter and flush inlets of this unit, product of the Aerotec Corporation, permit closer

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Many prominent contributors

One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors Among them are such men as Thomas J Watson, President, International Business Machines Corp, Frederick W Pickard, Vice President and Director, E. I du Pont de Nemours & Co, Clifton Slusser, Vice President, Goodyear Tire & Rubber Co, and Herman Steinkraus, President, Bridgeport Brass Company

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Only three inches in diameter

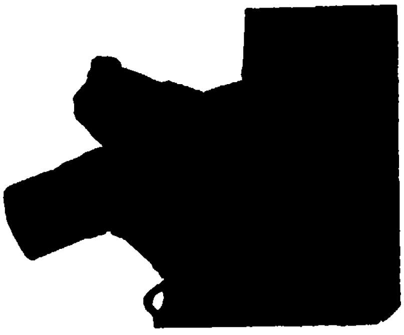
spacing of the tubes, and reduce eddy currents normally present with protruding wing-type inlets

An interesting side light on a similar Aerotec tube, is the fact that it serves as the fly ash eliminator between combustor and turbine in the latest developments of gas turbines for locomotives As a result of this performance, tests were run to determine the resistance of the cast aluminum tubes, developed in co-operation with the Aluminum Company of America, to fly ash, compared to steel and cast iron tubes, with a view toward powerplant applications Surprisingly, the aluminum tube was comparable to cast iron on identical abrasive tests This lighter tube, a permanent-mold casting, is produced to closer tolerances than any other method will permit

FEED-TRAVERSE DRIVE

Affords Stepless Speeds With Close Control

Composed of an A C traverse motor and a D C feed motor packaged into one unit, a new feed-traverse drive for machine tools has been developed by General Electric engineers The new drive is completely factory assembled, and produces a wide range of stepless feed and traverse speeds with close speed control Two developmental units have been applied to machines, and surveys are now being made to determine other important applications Both motors in the unit drive into a differential gear which has a single output shaft



Drive unit installed on combination drilling, milling, tapping, and boring machine

Individual mounting of the parts is not necessary, since the component parts are all assembled as a unit at the factory To install, the gear end of the unit is simply mounted on the machine to be driven. The unit can be easily inspected and oiled without removing it from the driven machine

Control for the motors is standard and it may be mounted wherever convenient.

On the developmental units, a traverse speed of 405 revolutions per minute was provided, and a feed speed range of 63 to 6.3 revolutions per minute Feed speed ranges of 20 to 1 or greater can easily be provided

REVERSE ELECTROPLATING

Forms Better Distributed Coat Of Greater Density

Reducing polishing costs as well as providing an electro-deposit of great smoothness, increased density, and decreased porosity, a process for electroplating involves a periodic reverse plating cycle in which the plating current is reversed briefly at short intervals Better plate distribution and thicker than normal deposits are obtained at higher current densities than are used in conventional processes

Laboratory study has shown that excellent results may be obtained with high-speed copper cyanide baths using a five-second plating to one-second deplating cycle However, in commercial practice it has been shown that a 20 to 4 second cycle, as well as cycles intermediate between this and the 5 to 1 second cycle, are quite satisfactory The PR Process, which is an engineering development of the Westinghouse Electric Corporation, has also been found to have advantages when applied to the Hanson-Van Winkle-Munning Amine Copper Process to the extent that higher current densities may be used and improved deposits may be obtained Early experimental work indicates that the process is also applicable to acid baths such as the conventional nickel baths

Equipment manufactured by the Hanson-Van Winkle-Munning Company which is available at the present time for use in periodic reverse plating consists of an electronic time-contactor unit capable of handling up to 50 amperes with a range of a fraction of one second to 25 seconds for each portion (anodic and cathodic) of the time cycle

BINOCULAR MICROSCOPE

Affords Three-Dimensional Vision For Minute Industrial Tasks

Magnifying objects in their normal three dimensions, a new industrial microscope is the outgrowth of experience gained in World War II when a special type of microscope was needed to perform many precise operations, such as the drilling of microscopic holes in Diesel engine fuel injection jets, the assembly of miniature radio and radar tubes, and the production of hundreds of other top priority war materials

As industrial microscopes were not available to meet the urgent demand, it became necessary to convert for war production work a binocular stereoscopic microscope developed by American Optical Company for medical and biological use Very shortly this type of microscope became one of the scarcest of all optical instruments, and carried one of the highest priorities

Three-dimensional image is right side up

In many operations, special fittings had to be designed to utilize the microscope, but there was no time during the hectic war days to redesign the instrument for industrial operations

The new industrial microscope, however, is specially designed and built to expedite numerous operations where minute details must be closely observed Work can easily be performed under the instrument because the magnified image is seen right side up and not inverted, while the optical system with converging objectives, achromatically corrected, clearly shows length, width, and depth with enhanced perspective

The microscope's two eyepieces are also mounted according to the normal convergence of the eyes for close work, are adjustable, reducing eyestrain when the instrument is used for long periods of time

The instrument can be used conventionally or bolted to a machine through a hole provided in the base It may also be attached to specially designed brackets on machines

ROTARY HAND PUMP

Measures and Dispenses Liquid at Rate of 10 Gallons Per Minute

Built with a meter registering eight gallons, and equipped with a 9999 gallon totalizer, a new rotary hand pump is intended for fueling or dispensing liquids up to 10,000 S S U viscosity The unit, manufactured by Bowser, Inc, includes a 40-inch suction pipe with bung attachment, an eight-inch oil-resistant discharge hose, and an aluminum nozzle The 10-gallon-per-minute pump also features an aluminum rotor, graphite-carbon vanes, cadmium plated packing nut, and stainless steel springs

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Compressed Air Handbook is a 400-page reference on applications, installation, operation, and maintenance of compressing equipment and air-powered tools of all types Much new and original data have been added to definitions, test standards, and basic tables and formulas formerly published as "Trade Standards" *Compressed Air and Gas Institute, 90 West Street, New York, New York —$3 00 in the United States, $3.50 elsewhere*

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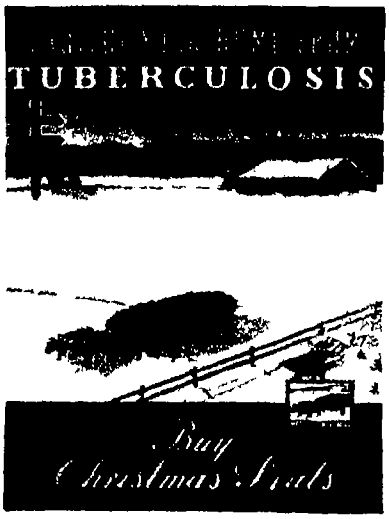

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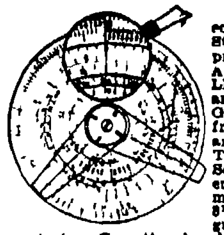

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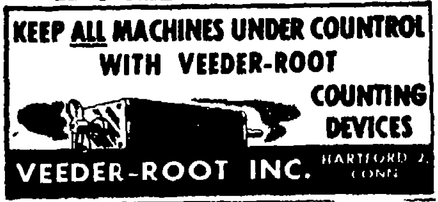

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A very good little one

A talking point for moderately small telescopes like the one shown, versus larger ones, is the same as for small versus big dogs A four-foot dog is eight times as bulky and hungry as a two-foot dog but he isn't twice as good a dog Benton A Wheeler, Little Rock, Arkansas, who made this telescope found his ten-inch instrument too bulky for his apartment The smaller one which resulted is as well equipped as a big one—has axes in two directions to point and control it Such a telescope, dissected into two or three main parts, will easily fit into a car without crowding out a mother-in-law Not dissected, it may (repeat may) do even this Numerous other amateur telescope making and using addicts have added special purpose telescopes to their collection

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Horace E Dall, 166 Stockingstone Road, Luton, Bedfordshire, England, has spent much time seeking such true lightness and portability—actual, not mere assertive portability—in vest-pocket telescopes that you will really carry them daily without a frown He has built four such telescopes, descriptions of which follow Of the four, two were successes and two were partial failures, a score that runs about average for TN optical projects There is almost as much value in describing failures as successes so these will not be omitted

Figure 1: Dall and his vest-pocket folding telescope. Magnification ×30

The first is a so-called spherical secondary "Cassegrainian" (actually the Dall-Kirkham telescope) of 3¼" aperture, a little gem of fine craftsmanship Figures 1, 2, 3 4

"This outfit," Dall writes, "was made to carry about with me on rambles mainly for terrestrial views but it will resolve stars down to Dawes' limit with a high-power eyepiece The entire outfit goes into my waistcoat pocket without jutting out more than a fountain pen It weighs eight ounces including a half-ounce portable stand (Figure 1) with tempered steel woodscrew end for quick attachment to the nearest gate post, window frame or what you like

"The power is ×35 to ×80, being continuously variable (pancratic) by pulling out the eyepiece an inch or so Other eyepieces may be used to give changes of power but each one gives the same range, about 2 1 The eyepiece is of the comfort type—large eye lens and eye point ¾" clear of the lens

"No instrumental scattered light is visible even near the sun

'The light grasp is decidedly better than that of a 3" refractor and the tele-

Figure 2: As taken from a chamois bag

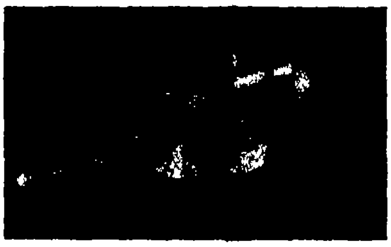

Figure 3: As screwed to fence post

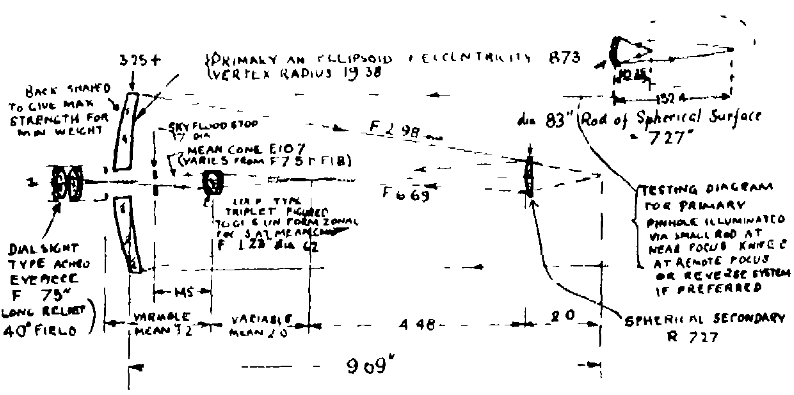
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Figure 4: Optical data for 3¼" Cassegrainian. No other data or instructions for building are available

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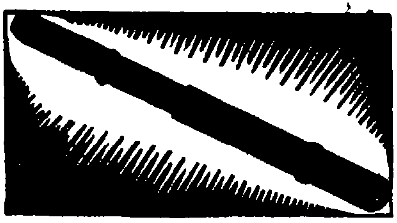

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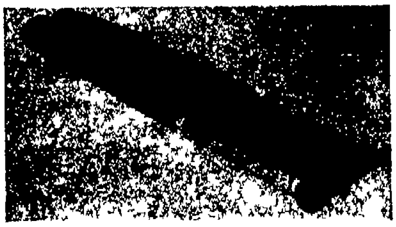

Figure 5: 1½-oz. pocket refractor

"The main ingredients of the mounting are duralumin and aluminum but some steel and brass parts are included where construction and strength demand

"The spherical secondary Cassegrainian is merely a means of saving figuring time without any improvement in performance but if the spherical secondary Cassegrainian is combined with the intermediate erecting system (Figure 4) adopted on my 15½" telescope described in Scientific American, May 1939, and for all my Cassegrainians since 1931, there is combined with simplification a very important improvement in general performance and an erect image

"This outfit is many times lighter than anything that has been made, of comparable performance A fair amount of work was involved, of more than usual precision Next letter, I'll send a photograph"

All this was written by Dall just before World War II broke out, and the promised photographs were delayed for the duration Reminded recently of the photographs Dall writes, "The vest-pocket 3¼" has been a great source of pleasure and has been carried and used on all holiday journeys since 1939 The Devon and Cornish coasts were our chief holiday centers during the war and I carried this 3¼", watching convoys sailing up and down the Channel Once, in 1941, during an air raid alert, a Czech refugee saw me using it and fetched a policeman who arrived with a screech of car brakes Fortunately for me, regulations were not so tight in 1941 as they became later and pocket spy glasses were permissible, and I escaped the clutches of the law and did not lose my telescope"

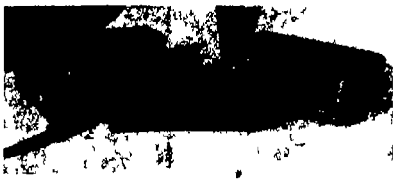

Figure 8: Hip-pocket Gregorian

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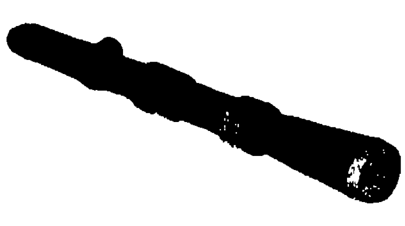

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two more portable telescopes for watching aerial dogfights. One (Figure 5) consisted of a 13/16" two-lens achromatic objective, a four-lens erector giving flat, wide field, and a four-lens, long eye relief eyepiece—the whole a small but carefully designed piece of optics The eyepiece plus erector alone serve also as an ×30 compound microscope Total weight, 1½ ounces This telescope is so successful that Dall carries it at all times It is high grade optics not to be confused with low-cost pocket telescopes of not very dissimilar external appearance The general public would not pay what such a telescope as this is worth

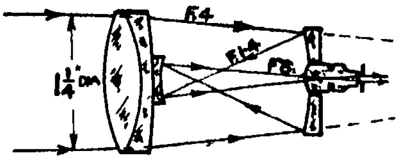

Figure 7: Optics of the early effort

The remaining two telescopes that were not complete successes are even more interesting They came near being successes and their description may challenge others to try to leap the same hurdles Descripton also offers free experience to others who plan similar designs, the wise being able to assimilate others' experience and profit by it, the not wise having to re-manufacture their own from scratch.

Figures 6 and 7 show a 1¼" Gregorian 2⅝" in length, ×20, made in 1928 "Disadvantages," Dall states, were "Although good objective lens, secondary spectrum was very evident at ×20 owing to short focus (about 5") Figuring done well but telescope highly critical to squaring on. Difficult to hold steady owing to shortness Field only 32° Close eye point and small hole"

Figure 8: Greg for specs, 8/10 oz.

Other details 1¼" achromatic objective, hyperboloidal ¾" primary, ½" Tolles eyepiece ¼" diameter, ellipsoidal secondary 1/3 diameter of objective lens cemented to the latter, screw focus, erect image In Figure 7, drawn by Dall, F 4, F1 4, F.8 refer to foci these many apertures distant. Partly related observations It is believed that some American amateurs have worked on reflecting binoculars Porter tried it as mentioned last month Wm Buchele, former amateur, Toledo—20" reflector described this department 1939, October, 7500 roof prisms in amateur roof prism program in war time, now Modern Optical Co.,—applied, 1943, for patent granted last December (U S Pat 2,413,286) on a Schmidt binocular

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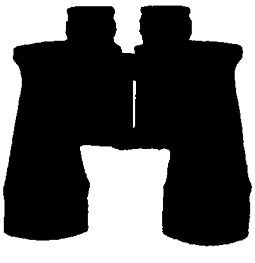

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but in most such designs the mirrors are too hard to anchor in collimation

The other Dall partial success is the miniature 1½", × 12, 6/10-ounce Gregorian shown in Figures 8, 9, 10 This was designed for attachment to the spectacles also shown To close it the primary mirror (into which the eyepiece is fixedly set) is folded down to right and the secondary mirror to left

Other details Eyepiece is an achromatic of 0 90" f l, 0.57" diameter Little "handle" seen projecting apparently downward projects actually to right and is a lever of the second class for focusing, it causes the respective halves of the telescope to move apart or together on two rod sliders

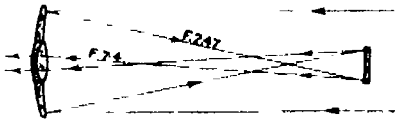

Figure 9: Optics of specs Gregorian

Troubles "But I couldn't get a proper cutting out of sky flooding," Dall writes, "with the system of quick hitching on to my 'specs' that I had in view (When the photographs were taken I hadn't yet designed hitching-on clip) The Ramsden disk, at ⅛" diameter, would, I first thought, just about fill my daylight pupil and eliminate the necessity for a sky-flood stop In practice it was too difficult to get the eye sufficiently well located coaxial and coincident with the Ramsden disk"

Figure 10: Specs Greg folded up

Score Two bull's eyes and two on the target

GEAR TRAIN for telescope drives, supplied by E B McCartney, 1205 W Minnehaha Parkway, Minneapolis 9, Minn, is a simple one It is 1 r p.m of Telechron motor drive shaft with 8 tooth pinion on it, 52 teeth in gear on end of worm, 221 teeth in worm gear around polar axis (Make worm gear on lathe with tap Using 10-pitch, sharp V-thread tap, gear will be about 7" diameter)

Gear reduction is then 1/6.5 × 1/221 = 1/1436.5, and polar axis will turn once in 1436 5 minutes

To detect pits in fine grinding, McCartney allows the gunk to dry, then wipes off with the hand The remaining white spots are pits

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